SCIENTIFIC AMERICAN

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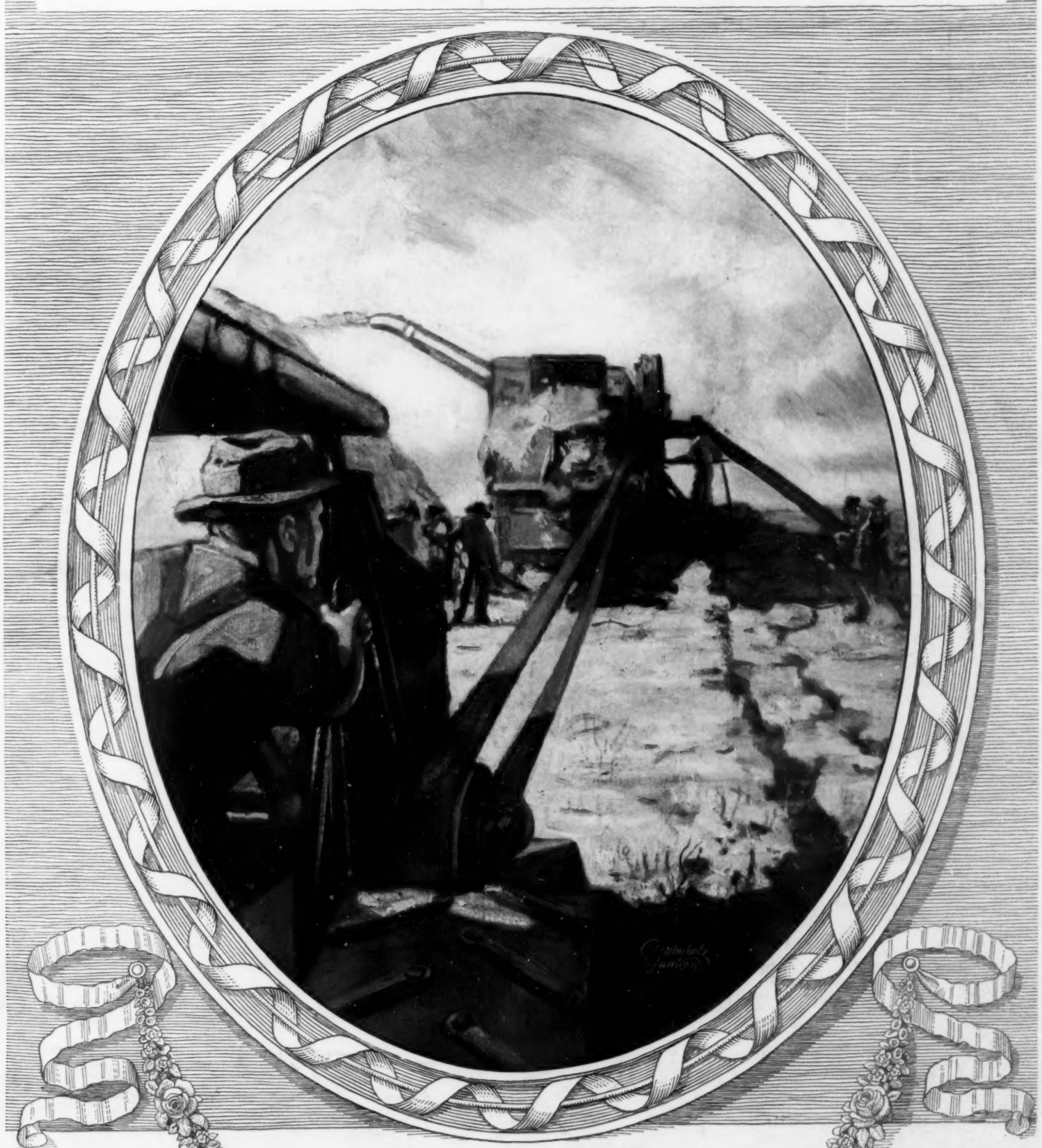

The Scientific Farmer

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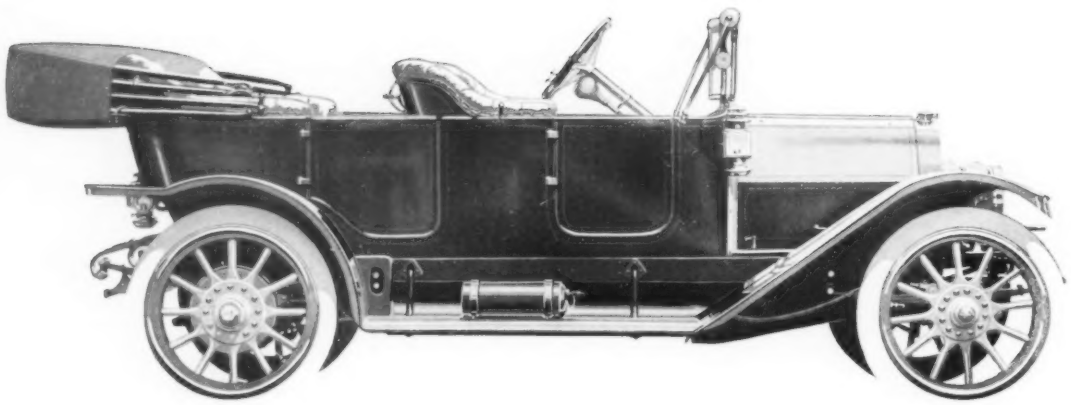
Overland



OVER fifteen thousand Overlands have been delivered during the last *five months*. This is *more* cars than *all* the automobile factories in Germany turn out in *a whole year*. This is an *increase* of 300 per cent. over the same period last year. And last year we *led* every thousand dollar automobile producer in America. Our 1913 sales are more than *double* those of any other manufacturer producing a similar car.

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¶ To meet the pressing demands of five million inhabitants, New York has been obliged to undertake the most stupendous aqueduct system in the history of the world.

¶ Hampered by its situation on a narrow strip of land that intrudes between New Jersey and Connecticut, this, the second largest city in the world, has had to look to the north, and the north only, for its supply of water.

¶ In the heart of the Catskills an entire valley has been swept bare and converted into a lake 40 miles in circumference.

¶ From this reservoir runs an enormous conduit that dips into valleys and under rivers, pierces mountains and bores through solid rock, 1100 feet beneath the Hudson River, to the Croton Reservoir.

¶ Thence down through the heart of the city, so far below the surface that the busy people above give no thought to the daily firing of tons of dynamite, the conduit is being gnawed through solid rock.

¶ Finally a pipe line extension will pass under the waters of the bay to Staten Island, 127 miles from the source in the Catskills.

¶ The whole marvelous story will be told in the Scientific American of March 1st.

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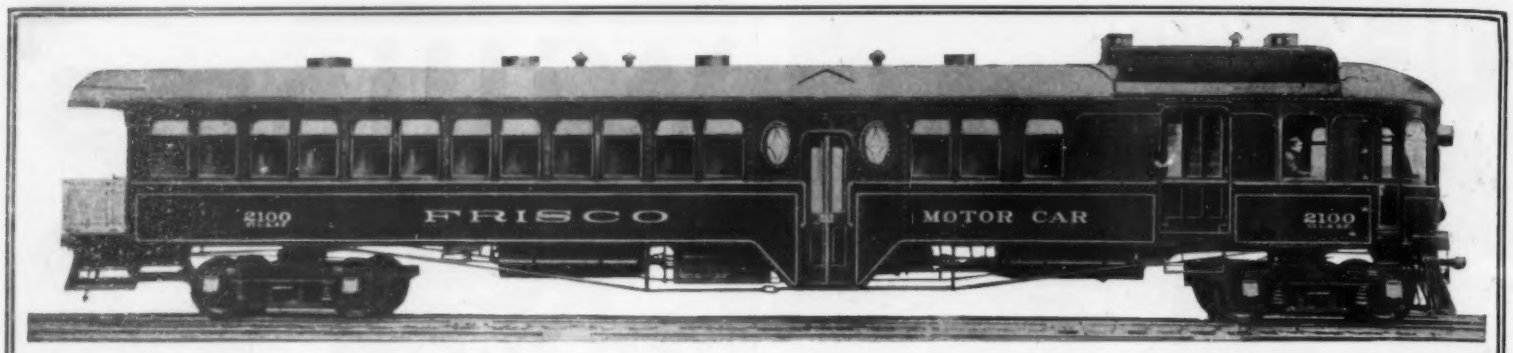

Better Train Service for Rural Communities

The applications of the General Electric Company's motors to extend irrigation, reduce farm labor, and provide modern lighting and other conveniences in the home are well known to the readers of these pages.

Now electricity is benefitting the agricultural districts in a new way, for the steam roads all over the country are adopting the Gas Electric Motor Car to provide greater economies and produce better traveling facilities on their branch lines.

This car is self propelled, and is a unique combination of the best features of the automobile, the trolley car and its predecessor—the steam train.

Like the automobile, its source of power is located in a gasoline engine placed in the cab near the operator, who can speed up, slow down or entirely stop the power at will. Unlike the automobile, however, the power is not transmitted by gears which would subject the machine to serious mechanical shocks and vibrations, but the engine is connected to an electric generator which feeds electric current to electric motors under the car.

Like the trolley car, the propulsion is accomplished by motors and control apparatus similar to that furnished by the General Electric Company to electric roads all over the country during the past twenty years.

Like the fast trolley car also, this car glides over the country, providing cool breezes for the passengers without dirt, dust or smoke in the summer, and with entirely closed and comfortable accommodations comparable with Pullman Car service in the winter.

Like the steam train, this car provides ample accommodations for the baggage, smoking and passenger traffic of the average branch line.

What this new train means to Rural Communities can best be judged by its phenomenal popularity both with the Railway companies and the traveling public. Twenty progressive steam roads have already placed over fifty of these cars in daily operation throughout the United States. In every case the results show that the quick and attractive service makes it easier for people to travel and conduct their business or seek pleasure, and that inter-relations between rural communities are greatly stimulated by the application of this modern invention.

Another advantage to the rural community comes through the fact that the highly economic operation of these cars makes it possible for the railroad company to insert more frequent local service between main line trains, thus materially increasing the efficiency of travel in rural communities.

When this car is placed in service in your locality you will undoubtedly show your appreciation by extended patronage of this modern method of branch line operation.

In the meantime, the manufacturing facilities and extensive experience of the company, which makes everything electrical, from the smallest size of Edison Mazda lamp to the Gas Electric Motor Car, are available for immediate application to your business, or in your home.

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1914

SIXTY-NINTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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The Rock-removing Machinery of the Suez Canal

By Jacques Boyer

THE Suez Canal traverses a diversified country. Near Port Said it passes through argillaceous sand and a few large beds of more or less compact clay. The bed of Lake Timsah consists of a hard conglomerate of sand and limestone; between Lake Timsah and the Bitter Lakes occur loose sand, mixed with clay, gravel and gypsum, and overlain by a layer of salt and other deposits left by ancient evaporation; finally, compact clay, marl, and sandy conglomerates alternate until the Red Sea is reached. No rock has yet been found, except in the southern part of the canal between kilometer 85 and Suez. Here the outcrop of the rock is almost horizontal. It occupies an area of 300,000 square meters (3,229,200 square feet) in the bed of the canal. The rocks include limestone of greater or less hardness, calcareous and silicious conglomerates generally containing shells, red calcareous tufa, gypsum and alabaster. In general, the rock is of medium hardness, except in certain deposits of compact limestone and sandstone.

In the construction of the Suez Canal, the rocky portions were removed before the water was admitted. In 1884, when the company undertook the work of widening and deepening the canal, it became necessary to devise means of removing rock under water. The hardest rocks were shattered by submarine mines, and the softer ones were removed by apparatus composed of a battery of 10 steel rams, weighing 3.5 tons each, which were raised and let fall on the rock in the manner of pile drivers. These same were placed on a floating bucket dredge which removed the rock as it was broken.

Experience soon showed that the efficiency would be increased by separating the rock breakers from the dredge and placing them on special floats. Although this arrangement produced an appreciable improvement, it still gave only a mediocre result because of the insufficiency in the weight of the breakers. From fourteen to sixteen blows per square meter were required to break up rock of medium hardness to a depth of ½ meter (20 inches).

In 1897, when it was decided to increase the depth of the canal to 9.5 meters (31 feet), the engineers of the company studied the question more thoroughly. They found that for the removal of rock under water, the method described above is more economical than drilling and blasting. Furthermore, the employment of explosives presents certain obstacles to the navigation of the canal. After each blast, for example, it is necessary to send down divers in order to make sure that the channel is not blocked by the shattered rock. The blasting method cannot be carried out on so regular a plan as the other, and it also involves the removal of an excessive quantity of rock in order to obtain the desired profile with certainty. A few years ago, therefore, the engineers definitely adopted a rock-breaking apparatus provided with two spindle shaped rams of cast steel, 13.5 meters (44.3 feet) long and weighing 13 tons each. These rams terminate below in replaceable points of very hard steel. The two rams are placed a yard apart and are raised by powerful steam winches which operate almost instantaneously through very flexible steel cables permanently attached to the tops of the rams. By means of this arrangement it is possible to hoist the rams very rapidly and to regulate without difficulty the height of fall, which ordinarily ranges from 5 to 10 feet. The two winches may be coupled in order to exert an exceptional effort upon a single ram which has become fixed in the rock.

The apparatus is mounted on a float 30.5 meters (100 feet) long, 10.57 meters (34½ feet) wide, and 2.44 meters (8 feet) deep, made entirely of Siemens-Martin steel. The falling rams are guided by a frame of special construction which also carries the pulleys over which the cables run. The float is moved forward, backward and in any direction rapidly by means of a steam winch.

Fig. 1.—Fourteen ton rock-breaking ram.

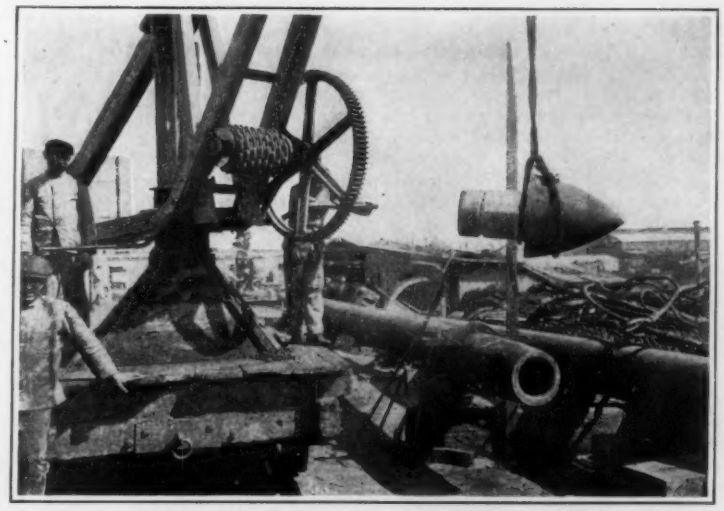

Fig. 2.—Placing in position the head of a rock-breaking ram.

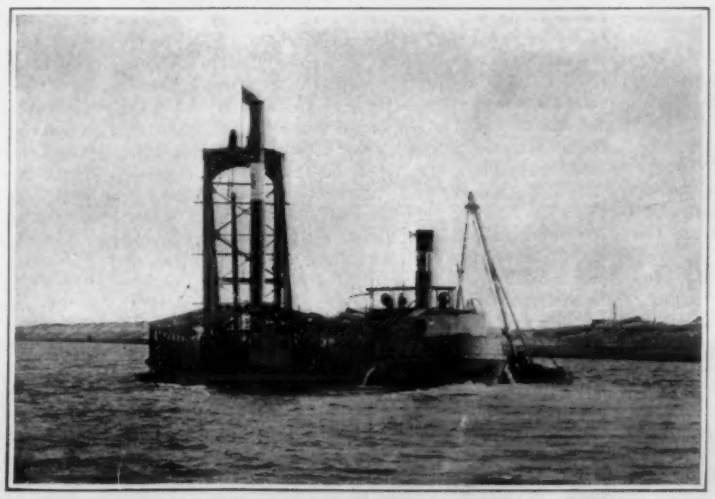

Fig. 3.—Rock-breaking float at work on the Suez Canal.

This apparatus was put into service in 1902, and since a few improvements in detail have been made, it has operated perfectly and broken all kinds of rocks without difficulty. In 1908 a second apparatus was installed, having two rams weighing 14 or 15 tons each and 15 meters (49 feet) long, which operate to a depth of 12 or 13 meters (about 41 feet). As a rule, 132 blows are delivered in each working hour. The mean thickness of the layer of rock shattered is 0.8 meter (31½ inches). In these conditions the number of blows required to break a cubic meter of rock varies from one to forty, according to the character of the rock. The average is about seven blows per cubic meter.

The output thus varies from 132 to 3.3 cubic meters (172.6 to 4.3 cubic yards) per hour with a mean value of 19 cubic meters (24.8 cubic yards) per hour.

Largest Embankment in Germany

AFTER eight years' strenuous work the Mauer embankment has been completed. This, the largest engineering monument of Silesia, and at the same time the biggest embankment in Germany, is situated in the Bober Valley between Hirschberg and Lähn, at a widening of the river where the Bober describes a strong inflection.

The masonry dam has been erected on a rocky soil, at about 66 feet depth; it is 196.8 feet in height, and at the bottom of the river 164 feet in width, and withstands a pressure of 440,920,000 pounds. The masonry on the side turned toward the water is provided with a cement coating reaching down to the ground, to prevent any water from penetrating into its interior.

The interior of the wall comprises shafts and galleries; it is at the surface 918.6 feet in length and 24 feet in width, and contains about 327,000 square yards of masonry. Being so exceptionally substantial, the dam will, it is firmly believed, check the most dangerous of Silesian rivers.

Upward of the masonry dam an artificial lake 5.6 miles in length will be formed, the embankment controlling a precipitation area of 463.3 square miles. The artificial lake will be 600 acres in area and 153.8 feet in maximum depth.

This embankment will be utilized on a large scale for supplying power to a considerable district of Silesia. The huge power house stands close to the outside of the embankment wall and comprises four turbines, each of 1,800 horse-power. As, however, this power house is connected with that of the Queis Valley embankment, near Marklissa, a total of 10,700 horse-power will be available, which suffices to supply the whole district of Liegnitz with electricity for lighting and power purposes.

The embankment was inaugurated on the 16th of November in the presence of the Emperor.

Some Facts About Granite

GRANITE is two and two thirds times as heavy as water; its specific gravity is 2.663. A cubic yard of granite weighs exactly three quarters of a ton. The strength of granite is tremendous, although the different granites vary greatly. Poor granites will withstand a pressure of 18,000 pounds to the square inch. Good, close-grained granite will withstand 30,000 pounds; but certain Wisconsin granites have withstood a crushing pressure of 43,973 pounds to the square inch—22 tons weight resting on a tiny cube of stone not much larger than a lump of sugar.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

A Fatal Blunder

BY remitting the tolls to coastwise ships that pass through the Panama Canal, Congress has dealt a death blow to American deep-sea shipping. Everyone who has studied the problem of the decadence of our Merchant Marine, understands that it is due to certain economic conditions over which we have no control. It costs so much more to build American ships and so much more to run them, that successful competition with foreign ships in the deep-sea carrying trade is out of the question. That is a fact which no one disputes. Also, it cannot be disputed that if we are to regain our former position as a leading maritime nation, some form of Government assistance is necessary. Call it what we will, whether subsidy, subvention, preferential duties or what-not, it is not denied and cannot be denied that Federal aid must be forthcoming, at least in the early stages of the upbuilding of our Merchant Marine.

Unfortunately, and thanks to the persistent misrepresentations of the stump orator and the yellow journal, there is a country-wide, though unwarranted, distrust of any proposed legislation which involves the principle of Government aid. The idea has been widely disseminated and too widely believed, that Government aid represents nothing more nor less than the transfer of funds from the public treasury to the private purse of individuals and corporations.

Now the fatuity of this matter of remission of Canal Tolls lies in this, that to remit these tolls to the already prosperous and highly protected coastwise shipping companies, is to do exactly what the yellow press has said would be done in every measure that contemplated Government assistance to shipping. To remit the tolls will be to make a free gift of $1.20 a ton to shipping companies which are already flourishing under the protection of a rigid monopoly.

So then, the first attempt of Congress to give assistance to shipping will be a glaring example of that very abuse of the excellent principle of Federal aid, of which the country, thanks to misrepresentation, is so greatly afraid. With this preposterous act before their eyes, it is certain that the people of the United States will become more firmly settled than ever in their unfortunate prejudice against any attempt, however commendable, on the part of the Government, to assist in the reconstruction of our Merchant Marine. Not only has Congress given assistance where it is not needed, but it has killed for a long time to come any hope of assistance being given where it is needed.

The Complete Eradication of Typhoid

A MEDICAL contemporary has asked us to say something on the subject of typhoid eradication by immunization, and we gladly present the salient facts of this very vital subject.

One of the most important steps in the march of medical science has been the recent successful work in the prevention of typhoid fever by the use of typhoid vaccine. It has been demonstrated that inoculation will enable an individual, or whole regiments of soldiers, for that matter, to live in typhoid-infected districts with complete immunity. It is not yet demonstrated just how long immunity will last; but it is known that protection is assured for at least one year. Typhoid immunization is harmless and in most cases causes no inconvenience.

Now the hope of the complete eradication of typhoid fever lies in the fact that the typhoid organism does not remain alive for any great length of time in water or the soil, two of the principal sources of the spread of the disease. Repeated investigation has shown that the typhoid bacillus will remain alive in natural water, only for a comparatively short time; furthermore, there is no evidence that the germ will live in soil longer than in natural water. Hence for the perpetuation of typhoid contamination in a well or some other water supply, there must be added, at comparatively short intervals, fresh typhoid bacilli from a case of typhoid fever or from a typhoid carrier.

Now here are two facts of supreme importance; for if typhoid germs "will not survive more than a few months when exposed to the elements during warm weather," as stated by the *Bacterial Therapist*, and if "immunized individuals cannot contract the disease for a year or more," it follows that by carrying out systematic immunization during the winter months, there would be so few typhoid cases the following summer that the disease would be practically eradicated.

If a general typhoid immunization were carried out by the concerted action of the health authorities of the various States for a few years, there is every reason to suppose that the terrible scourge of typhoid would be swept out of the country. The State laboratories could furnish the vaccine at comparatively little expense. Would the public submit to the practice of general immunization? Thanks to the present-day widespread knowledge on this general subject, and the public familiarity with the results obtained in controlling other diseases, we believe it would.

Is not general immunization well worth a trial?

Some of the Absurdities of the Proposed Compulsory License Legislation.

MUCH solicitude is evinced in the report of the Committee to whom the Oldfield Bill was referred for consideration, lest the existing patent laws "enable owners of patents to withdraw a large amount of personal property from the control of the States." The Committee declares: "Nothing is more fundamental in our government than the clearly marked line between the jurisdiction of the State and of the Federal courts." Nevertheless, the Committee recommends a scheme of compulsory license which gives every Federal district court throughout the United States power to hale before it every patent owner (except "original inventors") whose invention, for any reason whatsoever, has not come into use within three years after the issuance of the patent; to determine judicially the value of the invention and to compel the patent owner to grant to any competitor who asks it a license to use the invention upon such terms as the Court may fix. This would transform the seventy-two Federal district courts into "courts of patent commerce," to quote one of the witnesses before the Committee; for patents may cover collar buttons and steamships, tooth brushes and transportation systems, toilet articles and safety appliances, telegraph systems and tools, garments and foodstuffs.

How can the Committee reconcile such a proposal with its professed abhorrence of anything that may "ignore and override the jurisdiction of the State courts"? Such a scheme of compulsory license will diminish the inventor's market, enable any strong competitor to crush its weak rivals, impede every patent owner in developing and introducing his invention, retard the patenting of inventions, and discourage the large scale inventions and industrial experimentations on which civilization depends for solving the problems of existence.

To insure the non-enforcement of license restrictions, the substitute Oldfield Bill seeks to enforce solely against patent owners a Draconian code of business practice which is not and never has been imposed on any other class of property owners. Litigation under the Sherman Anti-Trust Act turns frequently, if not generally, upon close questions of law. By a salutary result of the existing law, property involved in all such litigation that is not in transit does not become forfeited if a combination in restraint of trade is found to exist. The substitute Oldfield Bill, however, provides that, under such circumstances, property in the form of patents shall be forfeited, while all other forms of property shall remain unaffected. Under the provisions of the bill, the vendor of any patented article becomes a criminal if he attempts to secure a year's business, as a condition of selling to a retailer; if he attempts to hold the retailer to his agreement to buy his patented goods, exclusively or to a certain extent; if he attempts to hold the retailer to his agreement, to maintain a standard price on the patented goods; if he licenses the use of a delicate patented machine on condition that it be used only with specially prepared supplies, or in continuity with specially adapted machinery necessary to insure perfect operation; if he licenses the use of a patented machine with the requirement that a minimum royalty shall be paid and that all or part of the licensee's work shall be done on the machine; if he attempts to limit the licensees' use of the patented machine to a certain class of goods or a certain character of work to the end that he may be free to license to others the exclusive use of his patented machine on other classes of goods or character of work; if the quality of his patented inventions is used to induce licensees to take his machines, either exclusively or in part, for all their needs; if he agrees with a retailer in a town to sell his patented goods to no one else in the same town or to sell to other retailers only on less favorable terms, in consideration of which the retailer shall push the sale of the goods; if he licenses the use of his patented invention to a licensee, who, for instance, makes steam engines of 1,000 horse-power, whom he charges a rate of royalty different from that charged a licensee making steam engines of less than 1,000 horse-power; or if he sells the patented goods in a particular territory at a price less than that at which he sells elsewhere.

Any of these transactions, which good morals and honorable business practice to-day and from time immemorial have always sanctioned, is made by the bill conclusive proof of the violation of the Sherman Anti-Trust Act. The fact that the transactions might reasonably be shown to have no tendency to restrain trade, cannot save the unlucky patent owner; for the bill expressly provides that "restraint shall be conclusively deemed to have been or to be unreasonable, and to be a violation of the provisions of said act" (i. e., the Sherman Anti-Trust Act) as to any one guilty of these transactions. The penalty which the patent owner may suffer for sinning in the manner indicated is the forfeiture of his patents, a fine of $5,000 and a year's imprisonment, and a payment of three-fold damages and the costs of suit and attorneys' fees to anyone who comes in within three years thereafter and proves any damage.

Was it a twinge of misgiving concerning this whole attainder of business, or was it an exquisite malevolence toward the patent system in particular, that suggested the imposition of these penalties on patent owners only? For the substitute Oldfield Bill forbids only patent owners from doing these things, and expressly leaves the owners of every other form of property free. Unlucky patent owners caught in the mesh may reflect that if they had dealt only in unpatented goods, instead of wasting time and money in developing new inventions, which their patents published to the world to the end that in seventeen years the world may use them without cost, they could have avoided all their misfortunes. Is this the way by which Congress is supposed to "promote the progress of science and useful arts"?

Machinery on the Farm

MENTION farm machinery to the average man, and immediately he sees in his mind's eye a picture of ingenious harvesters, reapers, and binders. Perhaps, too, he may think of the tractor engine, to which so much space has lately been given in illustrated periodicals, both popular and technical. But only if he be a technically informed man is it likely that he will think at all of the stationary engine and its agricultural possibilities, although it may be confidently asserted that it plays an even bigger part in transferring from flesh and blood to iron and steel the burdensome work of tilling the soil and harvesting crops. On many American farms little engines may be found that vary in size from one and two horsepower to forty and sixty horse-power, and that are used for almost every imaginable purpose.

Just how extensive is this application of engines it is difficult to state with any degree of certainty. No accurate statistics are available to show the actual number of farm engines in use, but the number must be huge. For example, in 1911 three companies alone made upward of 100,000 engines ranging in size from two to fifteen horse-power. Eighty-seven manufacturers reported that they had sold since starting in business, 655,000 engines; while seventy-six firms reported early in 1912 that their requirements for the year were at least 705,000 engines. As nearly as we can determine, there are seven hundred and fifty manufacturers of gasoline and oil engines in the United States, and fully five hundred of these make a specialty of farm engines. Their output must be at least half a million engines a year.

It is safe to assume that there are about two million gasoline and oil engines on our farms at the present time—probably a conservative estimate. The number is being added to at the rate of about 500,000 annually. The average size of these engines is about seven horsepower.

Every one of the 6,361,000 farms in the United States needs one engine at least, and many of them need two or three engines. Even under present conditions profitable use can be made of from thirty to forty million gas engine horse-power on the farms of this country. Surely here is an opportunity ready to be grasped by the enterprising manufacturer.

Engineering

Railway Construction in 1912.—During the past year there was added to the railroads of this country less than 3,000 miles of new line, according to statistics complied by *Railway Age Gazette*. This is 845 miles less than the average for the past nineteen years. On the other hand, the total mileage of new line, commenced but not completed, is greater than it has been for five years past. Our steam railroad system is fairly complete, and it is natural to look for a decrease in new construction as the years go by.

The Artesian Wells of Australia.—The artesian well is one of the most important sources of water supply in Australia—a continent which is by no means lavishly supplied with the snow- and glacier-fed rivers which are so abundant in this country. A government report states that in 1911, in the State of Queensland alone, there existed 785 artesian wells, whose total depth aggregated 334 miles. Of these, 113 were over 3,000 feet deep, and one of them had been carried to a depth of 5,045 feet. Two of these boreholes, alone, gave a combined outflow of nearly 15,000,000 gallons daily.

Elasticity of an Alloy Spring.—One of the most important developments in metallurgy of recent years is the success which has been obtained with the various new alloys. We have before us the record of a test made on a vanadium-steel, automobile spring, which measured 56½ inches between centers and had a camber of 8½ inches. Ths spring was deflected under a load of 1,150 pounds to a straight line, and then under a load of 5,800 pounds it was deflected 15 inches. Finally, pressure was applied until the spring was reversed to what was practically a circle, without showing any sign of fracture.

Peat-producer Gas.—Chief B. F. Haanel of the Fuel Testing Division of the Department of Mines, Ottawa, has reported that the peat-producer gas-power plant has proved its reliability, since operation may be continued for a week or longer without shutting down for cleaning or overhaul. A test plant has been run for 150 hours continuously; and the report states that in regular service it should not prove necessary to clean the pistons more than once in several months. The output of the producer is uniform; fires can be cleaned without interference with the engine, and any operator of intelligence can run the plant.

Four-gun Turrets.—According to the Paris correspondent of *The Navy*, the two French battleships A-7 and A-8, to be laid down in 1913, will carry twelve 13.5-inch guns in three four-gun turrets. Are not the French putting too many eggs in one basket? One successful penetration by a high-explosive shell might put four guns out of action at once. Against this is to be considered the accuracy of fire and the considerable reduction of weight both in mount and armor. Our own three-gun mount embodies, we understand, a combined sleeve for all guns, and the three guns will be given the same training and elevation under the hand of one man.

Important Railroad Electrification.—The Secretary of the Interior may be premature in his belief that the electrification of all the transcontinental railways is at hand; but he is certainly justified in attaching great importance to the grant by the Government of permission for the Great Falls Power Company of Montana to transmit over the public domain the necessary power to electrify 450 miles of track of the main line of the Chicago, Milwaukee and Puget Sound Railway in Montana and Idaho. In respect of the length of track covered, this is by far the most important application of electric traction so far made to a steam railroad.

A Notable Railway Bridge.—In this age of notable construction, work which only a few years ago would have commanded world-wide attention, now is apt to attract not much more than local interest and comment. A case in point is the handsome railroad bridge, of the cantilever type, which has been built by the Pittsburgh and Lake Erie Railroad Company over the Ohio River, at a point about twenty-five miles below Pittsburgh. The total length of the bridge between back walls is 1,800 feet. The main cantilever structure, which measures 1,409 feet between centers of end pins, consists of a 370-foot end span, two 320-foot anchor arm spans, and a main span of the great length of 769 feet, which is made up of two 242-foot arms and a 285-foot suspended center span.

Twenty-five Knot Battleships.—The persistency with which the new 25,000-ton battleships for the British Navy are credited with a specified speed of 25 knots, raises the question whether the Admiralty has determined to merge the battleship and the battle-cruiser into one—a logical, and as it seems to us, a very sensible decision. Water-tube boilers, superheated steam, and the steam turbine have combined to render possible battleship speeds which could not have been thought of a few years ago. Our Navy Department has never favored the battle-cruiser, believing that our limited appropriations should be put into the first fighting line exclusively. England sets the fashion in naval construction; but if she builds 25-knot battleships, will the rest of the powers follow such a radical change?

Science

The Divining Rod Problem.—We learn from Count v. Klinchowstroem that a Society for the Elucidation of the Problem of the Divining Rod has recently been formed in Germany. The society counts among its members many men of prominence in the engineering and other professions, and represents a serious scientific effort to shed light on a much debated question.

Storm Signals of the World.—The English Meteorological Office has just published a revised edition of the brochure entitled "Provisional Summary of the Maritime Weather Signals at Present in Use in the Various Countries of the Globe," which exhibits the remarkable diversity of the signals in question and is a strong argument in favor of the adoption of a uniform code. Hereafter this publication will be revised and reissued annually as long as various codes are in use.

An Aeronautical Weather Station has been established at Bitterfeld, Germany, by a local firm engaged in the construction of aircraft, and has been placed under the direction of a competent meteorologist, Dr. H. Rotzoll. Information for prospective travelers in the air is furnished on the basis of the twice-daily telegrams of the Deutsche Seewarte, at Hamburg, and whenever necessary pilot-balloons are sent up to ascertain the direction and force of the air currents over Bitterfeld.

A Great Collection of Hebrew Literature.—The last report of the Librarian of Congress contains an account of the Deinard collection of Hebraica presented to the national library last year by Mr. Jacob H. Schiff, of New York. This collection was brought together during many years by Ephraim Deinard, of Arlington, N. J., and numbers 9,936 volumes and pamphlets, which cover a period of nearly three and a half millenniums, from the beginning of Hebrew national life to the present day. It is naturally very strong in biblical and rabbinical literature. "It forms," says the report in question, "an admirable beginning of a department of Semitica in the library, which the librarian hopes will develop into one worthy of the national library of a country in which the Semitic race is playing so important a role."

Using the Philippine Scouts to Fight Rinderpest.—The Veterinary Division of the Philippine Bureau of Agriculture is waging an energetic campaign against rinderpest, a disease which in former years destroyed annually upward of half a million cattle and carabaos in the Philippines, though the number has now been reduced to two or three thousand. A unique feature of this campaign is the extensive use made of the Philippine Scouts in searching for cases of the disease and also in patrol duty to prevent the introduction of infected cattle in regions where the disease has been stamped out. Last year a cordon of about 1,400 scouts gradually pushed southward as far as southern Pampanga and northern Bulacan, leaving the territory behind them free from rinderpest. About 150 of the Philippine Constabulary were utilized in the same undertaking.

A Novel Explanation of Glacial Periods was propounded by Prof. W. J. Humphreys, of the Weather Bureau, at the Cleveland meeting of the Astronomical and Astrophysical Society of America. Several times in recent years it has been observed that great explosive volcanic eruptions (Krakatoa, Pele, Katmai), by charging the upper atmosphere, in the isothermal region, with fine dust, have markedly diminished the amount of solar radiation received at the earth's surface. It seems evident that the effect of this process must be to reduce the temperature of the air near the earth, since the dust scatters a much greater amount of the solar radiation received from without than of the terrestrial radiation received from within, owing to the greater average wavelength of the latter. Thus a period of excessive volcanic activity if long continued would produce the thermal conditions of an ice age. The geological record furnishes evidence that such a period actually began shortly before the last ice age and has continued with diminishing intensity to the present time.

A New Idea in Storm Signals is now being actively discussed in the meteorological world. Heretofore various forms of flags, cones, drums, lanterns, etc., have been used to warn seamen that a storm is in prospect at the place where the signal is displayed, together with information as to the direction from which the wind is expected to blow in the same locality. These signals are well adapted for use in temperate latitudes, where storms are of great area. In the case of tropical cyclones, however, such as the West India hurricanes and the typhoons of the Far East, they do not give all the information desirable. If a vessel is about to leave port in these regions, the master wishes chiefly to know whether he is likely to encounter a cyclone along his route. A system of signals has been devised by Rev. L. Froc, director of the Zikawei Observatory, near Shanghai, and is now in use experimentally on the China coast, which gives notice of the occurrence of a cyclone anywhere over the adjacent seas, together with its probable course. The International Meteorological Committee is considering the adoption of a uniform code of such "non-local" storm signals for use in all tropical countries.

Automobile

International Test for Motor Sleighs.—The Imperial Automobile Club of Russia has organized an international test for motor sleighs to take place in the environs of St. Petersburg on January 19th. The trials will include driving over five versts of snow-covered road, and three versts of loose, untrodden snow. The first three of each trial will then compete in a special speed trial over both courses.

Acetylene Tank for Horse Wagons.—Partly with the idea of making the roads safer for the automobiles and their owners—who, of course, are the best customers of acetylene gas tank makers—one of the largest of these companies has brought out a miniature tank for use on horse-drawn wagons. The installation is similar to that on automobiles, the only difference being the size and number of the lamps required. One charging of such a tank will last for fully a month of ordinary daily use.

Rotary Motor for Automobiles.—While the rotary gasoline motor has proven a decided success in aviation, its use in automobiles has met with very little encouragement so far. Several systems have been given trials, but little has come of the attempts to adapt them for automobile use. The latest of them is the product of two Dutchmen who are at present in this country endeavoring to enlist the help of some of the large manufacturers. The motor is of the four-cylinder, two-cycle type, and so simple that the complete car, it is claimed, can be built for $400.

Carrying Motorcycles on an Automobile.—The new automobiles ordered by the German government have been fitted with "side pockets" large enough to accommodate two motorcycles, and have given a good account of themselves in the recent maneuvers. Entrance to the tonneau is effected from the rear, and the running boards of the automobile are utilized as storage spaces. The particular advantage of this arrangement is that, as long as the car is running well, the cycles are out of sight and do not interfere with the free movement of the passengers. Should anything happen to put the car temporarily out of position, no delay would occur in the delivery of messages, as the motorcycles would be immediately made ready and mounted by two members of the automobile crew.

Selling Polish at a Show.—Some of the exhibitors at the recent London automobile show were ingenious to say the least and one of them chose a novel means to keep his product in the public eye—or rather memory. At the stand in question, metal polish was exhibited and samples were distributed. A man at one end offered small sample cans but he was standing on a metal platform connected with a small induction coil. Those who stretched forth eager hands for the samples received a gentle jolt. Those who were eager enough for a sample and who could overcome their timidity were presented with them from the other man—minus the shock. The theory of the game was that it set people thinking. They remembered the shock and the remembrance brought to mind that particular brand of metal polish. Some time or other, the recollection led to a test of the polish. The remainder is obvious.

$10,000 Prize for New Motor Fuel.—In order to encourage inventors and chemists, the British Society of Motor Manufacturers and Traders has offered a prize of $10,000 for a volatile fuel suitable for use in internal combustion engines. The only restriction in awarding the prize is the requirement that all the raw material or ingredients be obtainable in the United Kingdom in large quantities, so as to make Great Britain independent of other countries in so far as motor fuel is concerned, and that the fuel can be manufactured at a commercial price. The offer is the direct outcome of the present agitation for the improvement of carbureting devices and the alarming increase in the price of gasoline. The value of the prize itself is, of course, very small when compared with the enormous royalties to be derived from a truly satisfactory process of producing the desirable hydrocarbons. It is merely an encouragement in investigation.

Curing the Smoke Evil.—With the practical necessity for eliminating the smoke nuisance and the efforts of very nearly every engine manufacturer turned in that direction, some tests recently conducted by the Royal Experiment Station for Testing Materials at Berlin are interesting. A sample of commercial motor lubricating oil was separated into two portions, one portion being treated with acetone, which dissolved the heavier constituents without impairing the lubricating value of the oil, and the other was tested in its normal condition. The results of the tests demonstrated that the "treated" oil was an efficacious lubricant and that it burned without producing either smoke or irritating odors. The normal oil, on the other hand, burned, emitted considerable volumes of smoke and an odor described as "highly irritating to the nose and eyes." The tests suggest that methods in vogue to abate the smoke nuisance are, perhaps, directed wrongly, and that chemical rather than mechanical means might better be employed.

Finding the protein present in grain by the Kjeldahl method.

Soil Analysis and Seed Selection

A New Problem in Agriculture

By L. V. Redman
Department of Industrial Chemistry of the University of Kansas

The chemist in agriculture is concerned with two main problems. The first deals with the composition of the soil and the availability for plant life of its constituents. The second has to do with the selection of seed according to its chemical composition with the object in view of obtaining, not a greater number of bushels of grain per acre, but a greater yield per acre of any one chemical constituent contained in the grain. This latter problem, the application of the law of natural selection to the increase in yield of any one chemical compound present in grain, is new and inviting.—EDITOR.

An hydraulic hand press of 100,000 pounds for expressing oils, waxes, etc.

NITROGEN, phosphorus, potash and lime are the four "critical" constituents which every soil must contain if it is to be productive, and a chemical analysis reveals their presence or absence. A good soil to be termed rich must contain at least 0.4 per cent of soluble potash, 0.25 per cent of phosphoric acid, 1.0 per cent soluble lime, and 0.25 per cent of soluble nitrogen compounds. The other chemical elements which make up the bulk of all soils, are generally present in large proportions, and considerable variation in the amount of these elements present is not critical. An analysis reveals the constituents of the soil and the amount of each element present, but does not always give in a satisfactory manner the availability for plant food of the four "critical" elements. The reason for this lies in the fact that it is almost impossible to imitate faithfully the solvent action in the plant cell. No solvent has been discovered which will duplicate the conditions found in the growing cell of a plant. Dilute citric acid is the best single solvent for the purpose, although dilute hydrochloric and nitric acids are largely used by the chemists in this country.

When the chemist has determined the constituents present in any soil, he must further determine their availability. The constituent potash will serve to illustrate further the meaning of "availability." If potash is present in the soil as a constituent of the rock feldspar, it is "locked up" or not available, for the feldspar is practically insoluble; however, if the soil be treated with land plaster or gypsum, the potash is changed into the sulphate of potash, and is readily soluble and available for plant food.

And although a chemical analysis is not as comprehensive as one could wish for, yet sufficient valuable practical data can always be obtained by the chemist to repay the cost of the analysis many times over.

Influencing the Composition of Seed by Natural Selection.

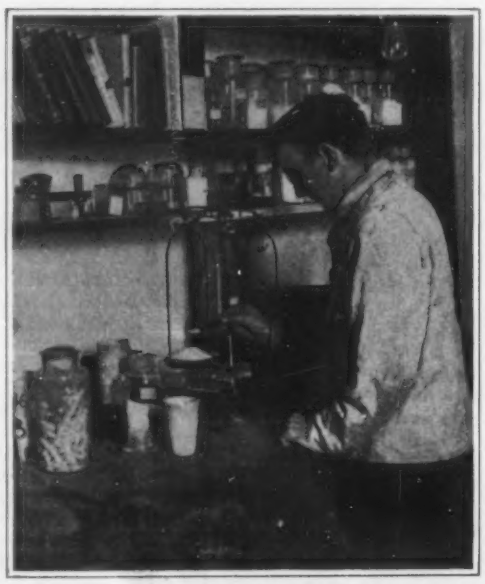
A chemical problem which bids fair to outclass others in importance is the selection for sowing of seed according to its chemical composition. The law of natural selection which is being applied with wonderful success to the improvement of races of domestic animals, and also to the gross yield per acre in grain production, may be applied with equal success to the problem of producing grain which has a more desirable composition chemically than the existing varieties.

To illustrate this point further, all grain is composed of three classes of chemical compounds, fats or oils, proteins, and carbohydrates (carbohydrates are sugars and starches). The oils, fats, sugars and starches supply heat and muscular energy to the body. The proteins build up the muscles and nervous tissue, and all mental processes are concerned directly with the breaking down of protein in some form. Proteins are the building materials of muscles and tissues, and the fuel of the brain and nerves, just as fats and carbohydrates are the materials for heat supply to the body. Any grain, therefore, which can be produced which will contain larger percentages of proteins than the existing varieties will serve two purposes. It will have a larger muscle-building value and nerve value, and its heating properties will be reduced. This is of considerable importance when one recollects that most grains, such as wheat and oats, used in the form of bread or as a regular cereal are at least fifty per cent too low in protein for the best support of the individual. The fat and heat producing factors are consequently fifty per cent too high. In corn alone the protein is one hundred per cent too low. Consequently, all cereal diets must be supplemented with meats which are very largely protein. If the protein content can be increased one hundred to two hundred per cent in grains, cereals could safely supplant a large part of our meat diets.

With these facts in mind it is evident that any research work which will increase the percentage of protein per bushel of grain will be of great value.

Some pioneer work in this direction has already been done by chemists. For example, at the Government Agricultural Experiment Station in the University of Illinois, there has been developed four distinct "strains" of corn, all from the same original seed. The first strain has forty per cent more protein than the original grain. The second strain has twenty-five per cent less protein than the original. The third strain contains sixty-five per cent more oil than the parent corn, and the fourth contains fifty-five per cent less oil. These changes have been accomplished by ten years of selection based upon chemical analysis.

What changes may be brought about in ten more years or half a century of selection is impossible to predict. A much-needed improvement in the muscle and nerve value of our ordinary grains may be hoped for, and a corresponding increase in muscle and nerve energy in the life supported on these cereals.



Weighing large samples in chemical soil analysis.

Atmospheric Ozone Up to Date

ARTIFICIALLY generated ozone has attained a prominent position in technology, and is daily being put to new uses. What of natural ozone, that which occurs spontaneously in the atmosphere? Half a century ago this substance was regarded as nature's great scavenger. Then, and for many years thereafter, it was a commonplace that an abundance of ozone in the air betokened a healthful climate. "Ozone" was a word to conjure with, and figured conspicuously in the advertisements of health resorts. The air of forests, of mountains, of the sea, was supposed to owe its bracing effects to this gas. The degree of ozonization of the air was tested by the rate of change of some easily oxidized substance; especially the ozone papers devised by Schönbein and variously modified by subsequent authorities.

A deplorable amount of care and labor has been wasted on ozonometric observations according to the traditional methods, which are still kept up by certain meteorologists and hygienists. It has long been known that the so-called ozone reaction, indicated by the coloration of test-papers, is due partly and perhaps entirely to other oxidizing agents in the atmosphere, such as the oxides of nitrogen, hydrogen peroxide, and chlorine. Moreover, no allowance is generally made for the varying strength of the wind (with corresponding variations in the amount of air passing over the test-papers), the hygroscopic action of the papers, and various other sources of error.

Chemists have made quantitative determinations of the ozone present in a given volume of air, with remarkably discordant results. In reference books it is commonly stated, on the authority of Houzeau, that country air, 6 feet above the ground, contains on an average 1/700,000 ozone by volume. This amount would be perceptible to the olfactories, and Houzeau's estimate supports the popular belief that "ozone-bearing air" can be detected by its smell. On the contrary, Ilosvay (*Bull. Soc. Chim. de Paris*, 1889) was unable to find any certain evidence of the presence of either ozone or hydrogen peroxide in the air, but found on the other hand that all the so-called observations of ozone with test-paper probably relate to nitrous acid. More recently, Hayhurst and Pring (*Trans. Chem. Soc.*, 1910) made a great number of tests at various altitudes, with the aid of kites and balloons, and found that in every case the amount of ozone was too small to be detected, i. e., less than 1 part in 4,000,000,000 parts of air, up to 8,000 feet above the ground; while at greater altitudes, up to 10 miles, the amount increased, but still remained very small.

Ozone is produced in the lower atmosphere by lightning discharges and possibly by other agencies, but probably enters immediately into chemical union with oxidizable substances and therefore has but a momentary existence. The old idea that it is more or less permanently present in regions of the atmosphere inhabited by man and that its fluctuations are of hygienic importance is hardly tenable at the present day.

Nevertheless ozone exists in the atmosphere, and is beginning to be looked upon as a meteorological element of great significance. It is formed from oxygen by electrical discharges and by the action of ultra-violet light, and most actively when the gas is dry and cold. It is therefore reasonable to suppose that it occurs most abundantly in the upper atmosphere, miles above the earth, where the amount of ultra-violet radiation from the sun is much greater than in the lower air, where there are frequent discharges of electricity in the form of the aurora, moisture is almost *nil*, and the temperature is very low. The solar spectrum always shows strong ozone absorption-bands, proving that somewhere in the atmosphere ozone is permanently present. The blue color of the sky may be due partly to ozone. However, probably the most important function of the so-called "ozone blanket" of the upper air is its selective absorption in the thermal part of the spectrum, in virtue of which it lets solar radiation in much more readily than it lets terrestrial radiation out. (See SCIENTIFIC AMERICAN, August 6th, 1910, p. 107.)

Increasing the Food Supply of a Nation

How Intensive Farming is Practised in Germany

By Homer C. Price, Dean of the College of Agriculture, Ohio State University

A NATION'S food supply may be increased either by increasing the area cultivated or by increasing the yield per acre. In America we have been using the former method, and in Germany the latter method has been used. Within twenty years the cultivated area of grains in Germany has not increased over 5 per cent, but within this time the total product has increased over 60 per cent, due to the increased yield per acre. This increase has been due to the application of science to the practice of agriculture and has resulted from a better cultivation and handling of the soil, from the more abundant and intelligent use of stable manures and commercial fertilizers and from the selection and breeding of more productive varieties of crops.

A comparison of yields between single years is of little value because one year the crop may be abnormal due to an unusual season, but by taking an average for a period of years a representative yield is given that is a safe basis for comparison. In taking the government statistics of Germany, and making a comparison between the average yields for the ten years from 1883 to 1892 and for the five years from 1906 to 1910, they show that the following increases in crop yields have been secured by the German farmers within twenty years:

INCREASE IN YIELD IN FARM CROPS OF GERMANY IN TWENTY YEARS.

	Average Yield Per Acre.		
Crop.	Period 1886-1895 bushels.	Period 1906-1910 bushels.	Increase in 20 years.
Wheat	21.2	31.2	47.8%
Rye	16.6	28.3	70.0%
Oats	34.1	57.5	68.6%
Barley	24.5	37.2	51.8%
Potatoes ...	130.0	210.1	61.6%

Practically the same figures for the United States present a very different picture. Our yields are not only in most cases less than one half what they are in Germany, but the percentage of increase has been very much less as shown by the following table:

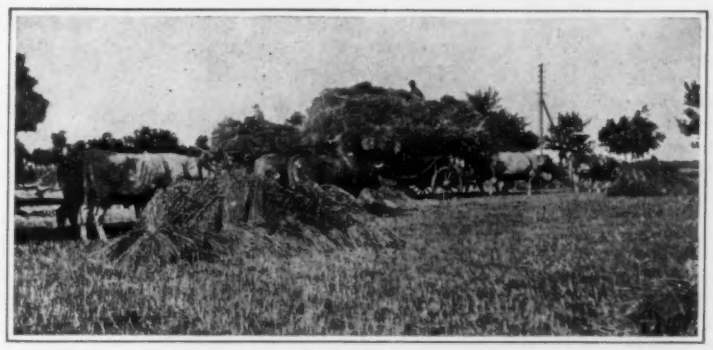
INCREASE IN YIELD IN FARM CROPS OF UNITED STATES IN EIGHTEEN YEARS.

	Average Yield Per Acre.		
Crop.	Period 1886-1895 bushels.	Period 1906-1910 bushels.	Increase in 18 years.
Wheat	12.7	14.7	15.7%
Rye	12.7	16.4	29.2%
Oats	25.6	29.0	13.3%
Barley	22.6	24.6	8.8%
Potatoes ...	73.2	96.9	32.3%

While the yield of wheat per acre in Germany has increased 47.8 per cent in twenty years, in the United States it has increased only 15.7 per cent, notwithstanding the fact that the yield in Germany is over twice as great as in America. A comparison of the tables will show that what is true of the wheat crop is true of the other crop yields. The German farmer is not only producing much more on the same area, but he is increasing his yield much more rapidly than the American farmer. And yet the German farmer has not reached his limit by any means, and one of the leading German agricultural authorities, Prof. Wohltmann, said recently that he was confident the German farmers could increase their present yields 40 per cent within the next twenty years. However this may be, it can at least be pointed out that the German crop yields are constantly increasing from year to year, and as yet there is no tendency to go back or even stand still.

What has made this rapid increase and why are the yields so much greater than in America? is the question that naturally arises. Primarily it is due to more intensive systems of farming, and certainly not to land that is naturally more fertile than in America. The German farmer spends much more labor and capital in the growing of his crops than the American farmer.

Harvesting the kind of crops that make Germany independent.



A typical German harvesting scene.

Courtyard of a German farmhouse.

Center of operations on a German farm.

His fields are prepared so that they look like a garden, and the soil is in fine condition before the crop is planted. He is more careful in the selection of his seed and his stand of the crop on the ground is more perfect. He has also learned how to feed his crops with fertilizers. In the first place he scrupulously saves every bit of waste on the farm and returns it to the land. Stable manures are carefully preserved and then generously supplemented with commercial fertilizers. The German farmer has learned how to use commercial fertilizers, and he knows they are not to be used to replace stable manures, but only to supplement them. He has also learned the necessity of keeping his land filled with humus to make it "crumbly" so that it is easy to cultivate and will hold rain water that falls on it. He does this by growing alfalfa and legumes, by plowing under green crops, and by the use of stable manures.

But back of all this are two causes that are fundamental. First, the active and effective work that the German government has done to develop agriculture. The European nations shape their policies on a war footing and the standard of efficiency sought is to be able to produce their own food supply in case of war. England long ago staked her security in her navy and sacrificed her agriculture to manufacturing and commerce and gave up as hopeless the producing of her own food supply.

Germany, together with the other continental nations, has maintained high protective tariffs on agricultural products and accepted it as a fundamental problem of national existence to produce in so far as possible her own food supply.

As a consequence an excellent system of agricultural education has been developed and an extensive system of scientific research through agricultural experiment stations is maintained. The governments of both individual States and the general government make generous appropriations for the development of agriculture, all looking toward the one goal—feeding the nation. Chambers of agriculture have been established in the separate provinces and are wielding a tremendous influence in the agriculture of the country. They not only look after the ordinary administrative affairs, such as the enforcement of inspection laws, but they are actively engaged in promoting the business interests of farmers through the organizing of co-operative societies, distributing the immigrant labor and every agency that promises to advance the interest of agriculture.

The second fundamental cause of the rapid development of German agriculture has been the efficient business organizations that the farmers have perfected along co-operative lines. This is particularly true in regard to credit. Intensive farming cannot be developed without an abundant expenditure of working capital, and before the American farmer can increase his yields per acre to anything near what the German farmer has done he must have capital that can be secured much more easily and at a much lower rate of interest than is the case at the present time.

German farmers, through their land mortgage associations, are carrying at the present time over one billion dollars in farm loans, and they do not pay over 4 per cent interest for any of it, and in many cases not over 3 per cent. There are also over 16,000 rural banks in Germany that are co-operative farmers' organizations, owned and operated by the farmers and having deposits of $250,000,000. Through these institutions the farmers secure loans for working capital on as favorable terms as is secured by any industrial class. The length of time for which the loan is made and the terms of repayment are adjusted to meet the requirements of agriculture, and in this way the German farmer has a great advantage over the American who almost invariably does his business on too little working capital.

The pessimist who predicts the rapidly approaching time when the farmers of the United States will not be able to produce enough for our own needs, overlooks the possibility of increasing the production from our present area as Germany has done. There is no reason why America cannot do equally as well if

not better. He also overlooks the possibility of adding to our present area by reclaiming our waste lands. The United States Geological Survey estimates there are 100,000 square miles of swamp land in the United States that can be reclaimed by drainage, and in the reclaiming of the arid lands by irrigation we have made but a beginning. The population of the United States may continue to increase for generations at its present rate and American farmers will be able to produce our own food supply if we foster and provide for our agriculture as do the leading European nations.

The Rise of Agricultural Meteorology

HOW much does unfavorable weather cost the farmer? To what extent is the loss from this cause preventable? Is it not time that meteorologists, plant physiologists, and practical husbandmen joined forces in an effort to find out more about the relations between weather and crops?

We cannot alter the weather—the opinion of Sunday Supplement vagarists to the contrary notwithstanding. We cannot temper the wind to the shorn lamb, but—may not the shearing be circumstanced to fit the wind? A thousand acts in our daily life represent so many ways in which we adjust our affairs to the immutable laws of nature. The secret of mitigating the loss which weather—and climate, which is weather in the aggregate—inflicts upon the crops is *adjustment of the plant to its atmospheric environment*. This may be accomplished especially in two ways; first, by the selection of varieties best fitted to the climate; and, second, by planting at such a time that the successive epochs of the plant's life will be most likely to coincide with suitable conditions of temperature, moisture, and the like. It is true that unseasonable weather will sometimes occur and defeat our best-laid plans; but in the long run the farmer who times his operations to agree with the normal march of the seasons in his locality will, other things being equal, get the most out of his land. However, before such a plan can be put into effect, we must find out a great deal more than is now known about the meteorological requirements of every species and variety of domesticated plant. This is the task of the agricultural meteorologist. Meanwhile, his colleague, the physical meteorologist, must aid the cause by carrying out detailed climatic surveys of agricultural lands. Intensive climatology is still in its infancy; and conventional climatic statistics are of comparatively little value to the agriculturist, because they ignore local features.

There are many indications that agricultural meteorology is at last coming into its own. A notable conference on this subject was held at the last meeting of the British Association for the Advancement of Science. An International Commission on Agricultural Meteorology, recently appointed by the International Meteorological Committee, held its first session in Paris last September. Most important of all, the International Meteorological Committee itself, which embraces in its membership the directors of the principal national weather services of the world, will hold a conference on agricultural meteorology at its triennial meeting in Rome next April. The International Institute of Agriculture, with headquarters in Rome, is deeply interested in this subject, and has recently published a report showing just what the existing meteorological services of the world are doing for agriculture. While the recent agitation of the subject centers in the Old World it has spread to our own country, and only a few weeks ago the Chief of the United States Weather Bureau assembled a number of his lieutenants at Atlanta to consider what steps should be taken for promoting closer relations between that Bureau and the agricultural colleges and experiment stations.

Of all the investigations hitherto undertaken in the scientific borderland between meteorology and agriculture the most grandiose are those now being carried on by the Russian government, under the direction of Prof. P. I. Brounov. About 150 stations, scattered over the empire, have been specially equipped for such investigations. Each station comprises small plots of land on which a certain succession of crops is grown year after year, and meteorological instruments are installed in immediate proximity thereto, in order that strictly parallel observations may be made upon the crops and the weather. The most important fact revealed by these experiments is the existence of certain "critical periods" in the life-history of each plant when the character of the weather markedly affects the yield. In other words, the total amount of heat, sunshine, rain, and so forth, received by the plant during the whole period of growth are much less important than the occurrence of definite amounts at certain times. In this respect, each species and each variety has its special requirements, and up to the present only the principal staples have been studied in detail. Already, however, Russian farmers have become impressed with the expediency of consulting Prof. Brounov and his staff about the choice of crops and the best time to plant.

The farmer lives by the weather, and it behooves him to know as much about it as science can teach him. It is passing strange that there are many agricultural colleges at which no course is offered in meteorology. Strangest of all—while there are many excellent treatises on marine meteorology, and medical meteorology, and even aeronautical meteorology, an adequate work on agricultural meteorology has yet to be written.

"Myriawatt" a New Unit of Power

THERE is no difference in the measure of power whether produced electrically or by steam, by wind or by water. There is absolutely no reason for holding to the old unit "horse-power," based on the power of an impossibly strong horse, when we have the "watt," based on the rational centimeter-gramme-second system, merely because the former is commonly associated with mechanical power and the latter with electrical power. Logically the name of Watt should be more closely associated with steam than with electricity. The term horse-power is falling into disuse among electrical engineers. It is so much easier to rate the power of an engine which drives a generator in terms of kilowatts. In fact, with direct connected engines and generators, it is very difficult to separate the mechanical energy from the electrical energy.

But before the engineer can rid himself entirely of the old arbitrary units, there is still to be abolished a unit that is even more senseless than horse-power for the reason that the name is practically the same, and yet the value is entirely different. Ever since 1876, when the unit was adopted at the Centennial Exposition, boilers have been rated in boiler horse-power. It is defined as the capacity for evaporating 30 pounds of water from 100 deg. Fahr. temperature of feed water to steam of 70 pounds gage pressure. When this unit and the common horse-power unit are both reduced to the common standard of the British thermal unit, we find that the boiler horse-power is thirteen times that of the common horse-power. Clearly then boiler horse-power is a misleading term and has no real reason for existing. In an effort to get rid of "horse-power" entirely, a paper was recently presented to the American Institute of Electrical Engineers by H. D. Stott and Haylett O'Neill, suggesting that the term "myriawatt" be used instead. The term is derived from the Greek "myria," meaning ten thousand, and the term "watt." One boiler horse-power very nearly equals ten kilowatts or ten thousand watts. Hence "myriawatt." In terms of British thermal units, one kilowatt is equal to 3,415 units per hour and one boiler horse-power to 33,475 units per hour. A "myriawatt" would then be 34,150 British thermal units per hour or only two per cent more than the boiler horse-power. It is the common practice to rate water tube boilers at one boiler horse-power per ten square feet of heating surface. As this is an arbitrary measure, no harm can be done by increasing the unit two per cent, and boilers might hereafter be rated at one "myriawatt" per ten square feet of heating surface.

At a joint meeting of the Standard Committee of the American Institute of Electrical Engineers, and a special committee appointed by the American Society of Mechanical Engineers, the new term was recommended and Mr. C. O. Mailloux was appointed to present this unit to the International Electro-Technical Commission at Zürich. It seems quite probable that the term will be adopted abroad, where "boiler horse-power" is never used, and no suitable substitute exists.

The new term permits the use of a simple system of determining the over-all efficiency of a plant. For it is only necessary to divide the kilowatt output by the myriawatt and multiply by ten to obtain the per cent of efficiency. The input of a plant and its output need no longer be stated in different and unrelated units of power. All power can be measured in terms of a single unit. Blessed is the man who makes one word grow where two words grew before.

Teisserenc de Bort (1855–1913)

AMERICAN meteorologists thought of the late Léon Teisserenc de Bort as "the French Rotch," and of the late A. Lawrence Rotch as "the American Teisserenc de Bort." Both men enjoyed ample private fortunes and were generous patrons of meteorology; each of them built and directed a private meteorological observatory; and each was the great pioneer aerologist of his country. This parallel has unhappily been completed by the death of both in middle life, and within a few months of each other.

Teisserenc de Bort was born in Paris, November 5th, 1855. From 1878 to 1892 he held an active position, and from the latter year onward an honorary position, on the staff of the Central Meteorological Bureau of France. In 1896 he founded his observatory of dynamical meteorology at Trappes, not far from Paris, and here he began about 1898 the series of sounding-balloon ascensions which led to the astonishing discovery of the isothermal layer of the atmosphere—first formally announced to the French Academy of Sciences in 1902. Twentieth century meteorology may be said to date from this achievement, as nineteenth century meteorology did from the discovery of the law of storms.

Even had he not discovered the isothermal layer—which he subsequently renamed the "stratosphere"—Teisserenc de Bort would rank with the greatest meteorologists. His idea of "centers of action" in the atmosphere is pregnant of practical and theoretical results not yet fully realized. He was one of the foremost advocates of the world-wide outlook in meteorology and the founder of the plan of collecting daily meteorological reports by telegraph from stations all over the globe now being elaborated by an international commission, of which he was president. His charts of high-level isobars, and his discovery of the relations between anomalies of temperature and pressure, marked definite advances in our knowledge of the atmosphere. He was one of the creators of the international classification of clouds. He joined with Rotch in fitting out the expedition, on the yacht "Otaria," which established the existence of the antitrade winds above the northeast trades.

In company with H. H. Hildebrandsson he began some years ago the publication of a great historical work on dynamical meteorology, unhappily not yet completed. In 1908 he received the Symons gold medal of the Royal Meteorological Society, which is awarded every two years "for distinguished work in connection with meteorological science." He was recently elected a member of the Academy of Sciences.

The Growth of Stumps

IT occasionally happens, particularly with trees growing in wet or very moist soils, that stumps of the Cuban pine (*Pinus heterophylla*) and long leaf pine (*Pinus palustris*) continue to grow by laying on very narrow annual rings of woody tissue for a number of years after the trees have been felled. The stumps of Douglas fir (*Pseudotsuga taxifolia*) and redwood (*Sequoia gigantea*) likewise continue to grow in diameter for a longer or shorter period of time. It was observed some time ago in Florida that a good many stumps of Cuban and long leaf pines felled more than ten years previous had continued to form annually new layers of growth. These annual rings are very narrow, often only from three to six cells wide, and are indistinctly visible even under the high power of the microscope.

What appears to puzzle the forester most of all is how the roots retain their vitality for such a long time and supply the cambium of the stump and larger roots with a sufficient amount of manufactured food to deposit layers of wood. Before the food material can be utilized by the tree it must be manufactured in the leaves. A chestnut tree, for instance, produces new shoots from the root collar as soon as it is felled and the leaves on these young shoots supply the root system with elaborated food. The stump thus continues to live, but the pines do not ordinarily produce stump shoots and can not manufacture food material for themselves. It would seem reasonable to conclude, therefore, that the roots of these pines are parasitic and are grafted on those of the neighboring trees, which supply the pine stumps with the required amount of prepared food. The roots of closely allied species of trees often unite, especially in shallow wet soil, where the roots of both young and old trees are near the surface and necessarily come in close contact with one another.

The irregularity with which the wood is often deposited clearly indicates that the roots of only one side of the stump have joined those of the living trees. Sometimes the fresh wood deposited on one side is more than double that on the opposite side. This new wood produced is often scarcely distinguishable from that formed naturally. The fibers or tracheids are usually interlaced and in an isolated state are curved and have blunt ends. The markings on the cell walls are similar to those of normally formed tissue. The compound microscope reveals the fact that the cell walls are slightly thinner and that there is little or no distinction between the early and late wood in these narrow zones.

Holland Gas Exposition

THE gas exposition of Amsterdam, which closed October 13th, 1912, numbered among its exhibitors 200 firms of different countries, only one of which was from the United States. It contained some interesting exhibits, such as the model of a Utrecht factory for making gas from petroleum residue by a process of dry distillation. This invention is considered of especial importance to the United States on account of our large production of petroleum. Other exhibits included a safety gas meter having automatic devices for preventing asphyxiation from escaping gas; an electrical gas lighter having a lighting switch against the wall, and a burner and mantle which can be used with either end up.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Effect of Reservoirs on Freshets

To the Editor of the SCIENTIFIC AMERICAN:

Mr. H. R. Flint's article on the control of the Mississippi, in your January 11th number, contains an important fallacy which should not be passed unchallenged. Mr. Flint pretends that the existence of reservoirs, even those of "many square miles in extent," does not regulate or equalize the flow, for the reason that "the extra water that causes the flood comes on top of reservoirs already filled" by previous rains. In this assumption, however, he is quite mistaken, even if it were not true that the level of reservoirs in all modern constructions can be and is regulated according to requirements. The rate of flow over the spillway of a dam varies with the square of the head, or level of water in the reservoir above the edge of the spillway, and this head will of course, for a given quantity of water flowing into the reservoir, vary inversely as the reservoir's area. This is a fact of such common observation, even aside from any mathematical consideration, that no demonstration should be required. Water powers on streams are rendered useful in proportion to the storage capacity of the reservoirs back of them. The immense value of Niagara's power consists largely, if not mostly, in the greatest power reservoir in the world which lies back of it.

Of course, the existence of a reservoir must "lower the ultimate high-water mark attained by the stream" by just the amount of water added to the reservoir, and inversely as the time it takes to run out.

This is not in any sense analogous to the influence of a forested watershed on stream flow, as Mr. Flint assumes, because when the ground is saturated, the "reservoir" is filled to capacity and no longer stores any water.

Milwaukee, Wis. GEORGE W. COLLES.

The Alaska Reindeer Industry

To the Editor of the SCIENTIFIC AMERICAN:

I have just noticed in the issue of January 4th the letter of Mr. A. W. Williams, of Chena, Alaska, regarding the Alaskan reindeer herds, which, in view of the wide circulation of the SCIENTIFIC AMERICAN, I consider worthy of notice.

Mr Williams implies that the Bureau of Education's reindeer enterprise in Alaska is unsuccessful in that it does not provide a draft animal and a meat producer throughout all of the vast and varied regions of Alaska.

Mr. Williams has entirely misconceived the object of the Bureau of Education in this undertaking. It is neither the duty nor the endeavor of the Bureau of Education to furnish Alaska generally with a draft animal and a meat producer. Its Alaska reindeer industry is confined solely to the native population of Alaska; its object is to provide assured means of support for the natives of the vast untimbered grazing lands of northern and western Alaska, which are adapted for reindeer raising; in this it has been eminently successful.

Instead of being "confined entirely to narrow strips of land bordering the oceans," the reindeer industry affects a region approximating in length the distance from Maine to South Carolina. In this region reindeer herds are found in the valleys of the Noatak, Kobuk, Selawik, Yukon, Kuskokwim, and other rivers, at many points hundreds of miles from the coast. The northernmost herd is near Point Barrow, on the shore of the Arctic Ocean, in latitude 71 degrees 27 minutes, longitude 156 degrees 20 minutes; the southernmost herd is at Ugashik, in southwestern Alaska, forty miles from the North Pacific Ocean, in latitude 57 degrees 50 minutes, longitude 154 degrees 50 minutes. A straight line from Point Barrow to Ugashik is approximately 960 miles in length. A line connecting each of the fifty-three herds would be more than 5,000 miles in length.

The official reports for the fiscal year ended June 30th, 1912, show a total of 38,307 reindeer in Alaska, of which 624 natives own 24,003, or 62 per cent, representing at an average value of $25 a capital of $600,075. The total income of the natives from the reindeer industry during the fiscal year, exclusive of value of meat and hides used by the natives themselves, was $44,885.04.

Mr. Williams's statement that my natives (I was the superintendent to whom he referred) "had to shovel snow several hours in order to enable the reindeer to reach their food," and that the Government had required "the continued services of between thirty and forty men to shovel snow off the moss" or the Holy Cross herd, is without foundation. No men were employed to shovel snow and, so far as I know, none was shoveled. On the trip to which he has referred, I used reindeer as draft animals all winter, covering a trailless country from Unalakleet to Cold Bay, *via* Kuskokwim, Nushagak, and Iliamna, traveling a distance of more than 2,200 miles—a record to compare favorably with that of the best dog team in Alaska, when cost, comfort, and condition of trails are taken into consideration. I neither broke trails on snow shoes, nor pushed behind handle bars—I rode.

W. T. LOPP,
Washington, D. C. Chief of Alaska Division.

What is Mentality?

To the Editor of the SCIENTIFIC AMERICAN:

In recent years I have had more or less to do with feeble-minded people, and have come to a new realization of how much mentality depends on physical organization. This experience has materially modified theories previously held as to the genesis of the individual mind.

My present theory is this: Mentality, thought, consciousness, whatever you will, is the expression of the reactions that occur between nervous (electro-chemical?) energy and energy generated in the blood stream. The brain alone is usually spoken of as the organ of mind, but the brain in itself is as powerless to produce mental action as a dynamo to produce electricity without conjunction with some external force. This external force in the case of the brain is the energy produced by the blood. All brain action ceases at once if the blood supply is shut off, and the individual drops into the blank of extinction.

A long array of facts, inexplicable by the brain theory, are reasonably explained on this hypothesis of brain and blood interaction. The normal mind arises from normal blood and brain. When either of these is abnormal, or both abnormal, the resulting reaction is abnormal and we have the abnormal mind.

The animal body is a wonderful chemical laboratory, and the blood it manufactures is composed of many chemical elements contributed by the numerous glands and other tissues. Now if any of these glands and tissues are defective or absent, so that the elements they furnish are defective or missing, the blood is thereby made defective and a defective mentality results. If a person has a diseased thyroid gland, or if it is missing, we have the cretin, a feeble-minded person. If this gland has such decided influence on the quality of mind, may it not fairly be assumed that other glands have a similar influence? Indeed, we know they have. The gelding has neither the robust mentality nor the robust physical constitution of the entire animal.

In all the past and up to the present, mankind has been unable to discover the real nature of insanity, epilepsy, feeble-mindedness, because they have looked for the cause in the brain alone or in the nervous system, or in the secretions alone; the secret lies probably in the reactions indicated, and these have been and are still beyond detection.

Everything that comes into existence does so through some process. In a universe where everything is inexplicable in its ultimate to the human understanding, is this hypothesis as to the genesis of the individual mind unreasonable? Henri Bergson says: "From this ocean of life in which we are immersed, we are continually drawing something and we feel that our being, or at least the intellect that guides it, has been formed therein by a kind of local concentration." Supposing that there is an ocean of life or an ocean of mind, still there must be an individual process to generate the individual life or mind, there must be this "local concentration" as Bergson terms it, and why should not the interaction of blood and brain energy be the process, seeing that both are necessary to life and mind?

Of course, individual, conscious immortality is destroyed by this hypothesis, for when the complex of forces is dissolved out of which the individual arises, body and mind, the personality is forever dissolved.

Perhaps this theory is not new, but so far as I am concerned it is. If a similar one has been advanced by anyone, I have not seen it. It it can be shown to be untenable, well and good. It is the truth, so far as we are able to comprehend the truth, that we want.

Fairibault, Minn. EDGAR ODSON.

The Fallacy of the Spring Wheel

To the Editor of the SCIENTIFIC AMERICAN:

For purposes of comparison, assume that a vehicle is equipped with full elliptical springs between the body and the axle and that the wheel is a "perfect spring wheel." When a load is imposed upon the vehicle, the elliptical spring and the bottom and top spring of the wheel will be depressed. This depression we may call the normal depression. If the wheel is to have the same shock-absorbing efficiency as the elliptical spring, then the normal depression of both must be approximately equal. In the case of the wheel springs, however, it is clear that the springs below the hub of the wheel and the springs above the hub are flexed in opposite directions, so that in one revolution of the wheel the springs in it must undergo a flexure of double the normal depression. Therefore, if the vehicle were driven over a perfectly level road, the elliptical spring would simply remain in its position of normal depression while the springs in the wheel would sustain a flexure of double the amount of the normal depression at every revolution. The spring of a 40-inch wheel would therefore sustain approximately 525 double normal flexures in every mile in addition to the flexures caused by the absorption of irregularities of the road.

The working of the springs due to the irregularities of the road will be the same in either case. Now, if we represent the amount of this working per mile by X, the normal depression by Y, and the miles by M, we can represent the comparative working of the two springs as follows:

Work in elliptical spring, MX

Work in spring wheel, $M(X + 1{,}050\ Y)$.

The springs in the wheel must therefore undergo 1,050 complete normal flexures in each mile more than the elliptical springs. This would develop an amount of heat and a rate of depreciation in the spring wheel which, in the opinion of the writer, makes it practically certain that no spring wheel, however ingenious and perfect in action, will ever become a practical success.

This same reason is recognized, even by the layman, as the cause for the rapid depreciation in automobile tires; but so far as the writer is aware, has never been recognized in connection with the spring wheel.

Plainfield, N. J. G. F. FISHER.

Panama Canal and Free Tolls to Domestic American Shipping

To the Editor of the SCIENTIFIC AMERICAN:

The note of Earl Grey to the Government of the United States in protest of the free tolls to American domestic shipping using the canal in trade between United States ports, made the point that if American shipping did not pay tolls, there would be no means of ascertaining the additional burden that would be laid on foreign tonnage.

That would hardly seem to enter into the case, at least not for many years, as Prof. Emery Johnson pointed out in his report to the United States Government that the United States would have to make up the deficiency in the canal revenue for years to come, even though American ships all paid tolls.

So as far as foreign tonnage is concerned, the United States allows foreign tonnage to use the canal at less than cost.

Free tolls for American domestic shipping is indefensible from every and any standpoint. It is in effect a subsidy to as great a monopoly as exists on the sea—American coastwise tonnage.

American coastwise tonnage is shielded from the competition of any foreign steamers. None but American-built craft can engage in the trade between the United States Atlantic-Pacific ports.

To give this tonnage free tolls is the same as handing it money from the United States treasury; and no thought whatever is given to the interests of shippers. No thought apparently is given as to the possible combination that may be effected by the owners of American coastwise tonnage that will engage in the trade.

And from the present reports of the activity in shipyards the world over, including the United States, it would not be a surprising thing to find that in the course of a year or two, it would be a difficult matter to place an order for tonnage and secure anything like prompt delivery; freights meanwhile being at the mercy of tonnage owners that have no more hesitation in charging all the traffic will bear than have railroads.

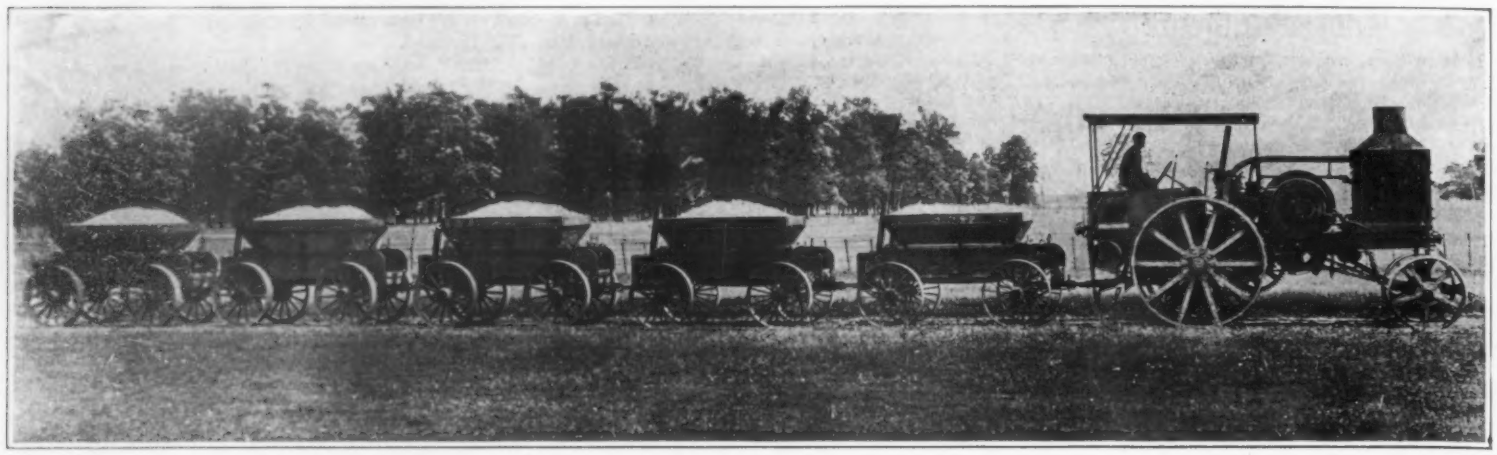
And besides this, there is a phase of the matter that so far has apparently not been touched: American steamers engaged in trade to foreign ports and using the Panama canal will have to pay tolls. While American steamers engaged in domestic coastwise trade using the canal will go through free.

On what grounds can Congress make such a distinction? It is class legislation pure and simple; discrimination of the worst sort; taxing American steamers engaged in foreign trade and exempting them in domestic.

No one has ever claimed that we would have to extend aid to tonnage to upbuild our coastwise trade. The efforts that have been made in Congress in the last decade have been in behalf of American tonnage that was to upbuild our deep-sea foreign trade. American tonnage on the deep seas "could not stand the competition of foreign steamers." "It cost more to operate the American; cost more to build and compete; it was necessary that Congress extend aid in the shape of bounty or subsidy;" and Congress turned a deaf ear to that part of the American merchant marine that did make a somewhat plausible showing, that needed aid, and later grants a measure of subsidy—for that is what free tolls is in effect—to that part of the American merchant marine that not alone needs no subsidy of any kind, but which is and has been favored as has the shipping of no other nation.

In the interest of American fair play, the free-toll measure should be recalled; that would be one justifiable act. And not alone in the cause of justice should it be, but on the ground of discrimination; there is nothing in the Constitution or in law that permits Congress to levy tolls on American shipping using the canal and destined for ports outside of the United States, and giving free passage to American ships destined to ports of the United States.

CHARLES DEPEREE.
Chicago, Ill.



Hauling twenty-two and one half yards of crushed rock in five dump wagons.

Economics of the Farm Tractor

The New Way of Tilling the Soil and What it Means

By Philip S. Rose

SINCE the very dawn of time, agriculture has depended upon the muscular power of men and animals to perform all of its heavy work. Even after all of the other great industries had adopted steam or gas or electricity, agriculture continued to plod along in the time honored custom, because, forsooth, nothing else was available. This condition continued until very recent times. About a dozen years ago the steam tractor was developed sufficiently to attract the attention of many of the large western grain farmers and then, less than ten years ago, the gas tractor, using gasoline or low-grade kerosene for fuel, made its first appearance. From that time forward the pace has been rapid.

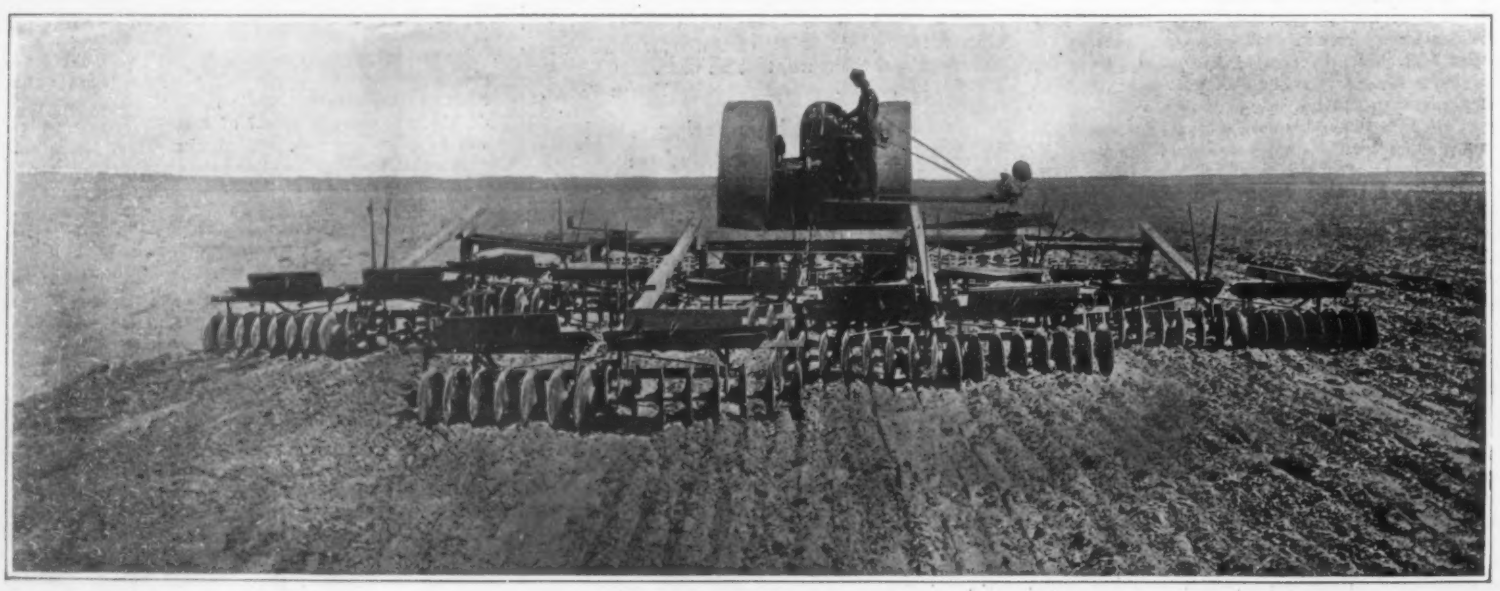
Farmers everywhere are now talking about power farming and thousands have become converts to the new idea. Six years ago there were not to exceed five hundred gas tractors in the United States. Last year more than thirteen thousand were sold, and this year the factories of the United States will turn out no fewer than twenty thousand. Five thousand of these will be sold in western Canada. Of the remaining fifteen thousand, some will go to South America, some to Russia and some to the various countries of Europe; but the greater number will be sold to the farmers of the United States.

Next year more than twenty thousand will be made and sold. The demand is greater than the supply and continues to increase from year to year. There are now more than eighty companies engaged in their manufacture, and new ones are being formed almost weekly. Such is the condition of the business, and its prospects for the future seem very bright indeed. It looks as though the commercial success of the automobile were to be repeated in the farm power field.

All this activity is easy to understand when one comes to consider the immense expenditure for power necessary to conduct the agricultural operations of the country. The total cultivated area of the United States is 477,488,000 acres, of which a little more than 43,000,000 is annually devoted to the hay crop, thus leaving about 435,000,000 acres that must be plowed and made ready for the crop each year. It is estimated that the average work necessary to plow an acre is about ten horse-power hours. At the Winnipeg Motor Contest last year the average of all trials showed that it required 15.41 horse-power hours to plow an acre, so the figure selected appears to be on the safe side. Using this as our power factor, we find that the total expenditure of power for plowing the ground once each year is 4,350,000,000 horse-power hours. In order to accomplish this task and do the other necessary work, which amounts to more than twice as much additional, there were, on January 1st of the past year, according to the report of the Secretary of Agriculture, 24,092,882 horses and mules on the farms of the United States. Their total value, as given by the same source, was estimated at $2,698,351,000. The average value per head is thus $112.53, which is certainly low enough. These animals are maintained almost exclusively for farm power use, and do not include those used in cities and villages. If we take into account the harnesses and other gear required before this power is available, estimated at fifteen dollars per animal, it is evident that the farmers have the prodigious sum of three billion dollars invested in power equipment.

If we assume in round numbers 480,000,000 acres as the total cultivated area, and three billion dollars as the investment, a

Billows of earth left in the wake of a tractor plow.



Majestically a huge tractor moves through acre after acre, drawing in its train a dozen agricultural implements.

little calculation will show that the farmers of this country have an average of $6.25 an acre invested in animal power. This sum seems excessive, but as a matter of fact it is greatly exceeded by many farmers. The truth of the figures becomes apparent when one considers that they provide only two work animals to each forty acres of cultivated land. Besides, the estimated value per animal is very low. There are hundreds of farms where the cost per acre is greatly in excess of the figure given.

Authorities differ as to the annual cost of keeping a horse. Grisdale, of the Ottawa Experimental Farms, reports an annual cost of $99.80 for each of the nineteen horses at the station farm. Burkett, of the New Hampshire Station, reports the average cost of keeping five horses at $74.33 each, while Cooper in Minnesota found the farm cost of keeping horses to vary from a minimum of $65.23 to $90.40. If we assume an average cost for the entire country of $75 per head, which seems reasonable in view of the above figures, we find the total cost of maintenance of this important industry reaches the enormous sum of $1,805,466,150, or $3.76 per acre.

The total value of all agricultural products for the year 1911, as estimated by the census, is $8,417,000,000, which amounts to $17.53 per acre for the entire United States. From this it will be seen that it requires 21.4 per cent of the products of the farms to maintain their work animals. In other words, more than one hundred million acres are required to raise food and pay for the maintenance of the horses and mules of the United States. Truly this is an enormous tax upon our national resources and at a time, too, when the production of human food is not keeping pace with our increasing population. Is it any wonder that farmers are looking toward mechanical power with eager hopefulness? These animals do not furnish food or clothing directly, and hence their total cost must be chargeable to the annual national farm power bill. In this discussion, it should be especially noted that we have omitted all interest and depreciation charges. If these were taken into account, we should have to add about sixty-two cents more to the maintenance charge per acre, which would bring the total up to $4.38, or almost exactly twenty-five per cent of the country's agricultural production annually.

While perhaps few farmers have ever kept an accurate account of the cost of keeping their work animals, they are, nevertheless, aware that they are paying an enormous price for the power needed to do their work. Not only are they paying a heavy price for the power itself, but the fact that it is divided up into such small units makes it necessary to employ many extra laborers during the busy season. The change to mechanical power operates in agriculture just as the adoption of improved machinery in manufacturing. It reduces the number of men required to perform a certain piece of work, and thus reduces the cost.

Owing to the nature of farm work and the fact that there is a long idle period during the year, it is difficult to maintain enough laborers in the country to do the work during the busy season. This fact, coupled with the high maintenance cost of work animals, has turned the minds of farmers toward mechanical power. They figure that they can well afford to buy a tractor instead of keeping a dozen or more horses. The tractor does not require special attention during the times it is idle. It does not cost anything for fuel while idle. It does not require as many operators as the horses it replaces, and it is able to turn out more work in a day. Moreover, it is able to work longer hours and during the hottest weather. The speed with which it can prepare a field for a crop or seed the ground after it is prepared is an important item, for it is well known that the yield often depends upon the soil condition when the ground was plowed or the moisture content of the soil when the seed was planted. A rapid machine like a tractor enables the farmer to take advantage of soil and climatic conditions much more successfully than when he depends upon horses.

It is true that the tractor is not adapted to the small farmer. It costs too much. Prices now range from $1,200 to $3,000. The higher price is for the larger machines which will develop anywhere from fifty to eighty horse-power.

These machines can easily do as much as twenty-five or thirty horses, while the smaller machines, which will develop from fifteen to forty horse-power, are fully equal to ten or a dozen horses. The first cost of the larger machines is not much if any greater than of the horses which they replace, while the cost of the smaller machines is not greatly in excess.

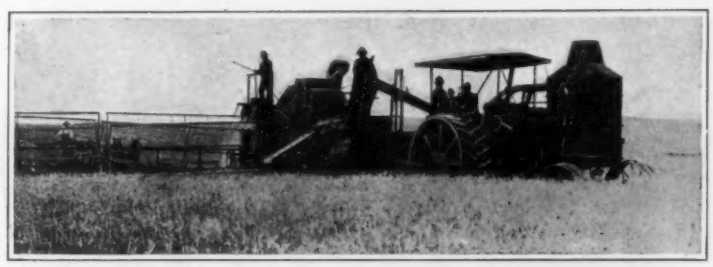
It is the general opinion of well informed tractor men that it will pay any farmer who has two hundred or more acres under cultivation, if his land lies right, to purchase a gas tractor. For a farm of that size he will need one of the smaller machines. His power bill for the year should then figure about as follows:

Interest at 6 per cent	$72
Depreciation	200
Fuel, oil and labor	160
Total	$532

At the average of $438 for all horse labor the total would have amounted to $876. These figures show a gain of $344 for the tractor.

Any set of estimates are liable to be misleading. Much depends upon the character of the farm where mechanical power is contemplated as to whether it will pay to make the change or not. The kind of farming and the mechanical ability of the farm owner or manager are the items that must come in for careful consideration. Perhaps the best way to approach the subject, and thus arrive at the fact, is to consider the experiences of those who have used gas tractors.

Pulling binders by engine power.



A kerosene tractor that does the work of many teams.

Hauling logs in Tennessee over roads that are roads only in name.

There is no place in this country where power farming is carried on more extensively than around Beach, N. D., and Wibaux, Montana. The farms are large and horses are used merely for driving purposes and to haul light loads from town if the farmer does not possess an automobile. All the heavy work, such as plowing, disking, seeding, threshing and hauling the crop to market, is done with tractors. Many steam tractors are used, but gas tractors are the favorite.

As an example of the amount of work a tractor can do in a season, take the record of E. G. Paul, one of the Beach tractor farmers. Last year he plowed 810 acres of sod, disked 800 acres, seeded 1,600 acres, harvested 1,440 acres and threshed and then hauled his grain to market besides doing a considerable amount of road grading. E. A. Beasley, a prominent farmer near Lake City, Iowa, says he finds his tractor more economical and satisfactory than horses. Joe Edgington, another Iowa farmer, reports that it cost him less than eighteen cents an acre to do his plowing last fall with an engine burning distillate. He used two and three quarter gallons an acre, which cost him six cents a gallon.

The most of Montana has been developed with mechanical power, and the three western provinces of Canada depend upon it. It would seem if these Canadian farmers can make power farming pay that the farmers of the United States would certainly find it profitable. In order to obtain some idea of the costs of operation and to obtain an expression of opinion regarding the efficiency of the tractor, I sent out a list of questions to forty-four Canadian farmers, asking the cost of fuel, cost of outfit, labor charges, repairs, etc., and finally asking for an expression of opinion in regard to the future of the gas tractor. Eleven replies were received and every one expressed the opinion that the gas tractor would soon displace every other kind of power in Canada. This, too, in face of the fact that tractors cost twenty-five per cent more than in the United States, and fuel fully twice as much. Several reported using gasoline that cost twenty-seven cents per gallon, and yet they were enthusiastic for the gas tractor.

The work reported as being done by tractors covers a wide range and includes all field operations, such as plowing, seeding, harvesting, hauling to market, threshing, corn shredding, grinding, baling hay, filling ditches, and road grading.

There is no question but we have entered upon a new era in agriculture. The farmer desires the comforts and advantages of the city dweller, and these he gets easily and cheaply with the small gasoline engine. He sees that the gas tractor is suitable for the heavier field operations, and is generally more economical than horses, and he is not slow to make the change. It enables him to accomplish more in a season. It multiplies his capacity and gives him either more leisure or enables him to farm a larger area and increases his income.

Power farming has just begun, and the start is encouraging. Whether it will accomplish the revolution in agriculture that it has in manufacturing and transportation only time can decide, but it seems safe to predict that it will bring about many interesting social and economic changes.

X-ray Pictures of Micro-organisms

By Dr. Alfred Gradenwitz

THE latest advance in the field of radiography is the use of X-rays for examining microscopic preparations.

If, in spite of the many-sided applications of X-rays, no attempt had so far been made to use them for microscopic study, this was doubtless due to the serious experimental difficulties to be overcome. A French scientist, M. Pierre Goby, at Grasse, has, however, by means of a special apparatus (particulars of which will only be made known in a short time) succeeded in removing these difficulties and investigating opaque microscopic preparations by radioscopy in all their most hidden details.

As pointed out in a memoir recently submitted to the French Association for the Advancement of Science, Goby at first placed his micro-radiographic work in the services of paleontology and conchyliology. The most primitive organisms (protozoa) all kinds of foraminifera and similar microscopic beings can thus be investigated in their innermost structure. Goby has even succeeded in ascertaining the existence of differences in species when ordinary methods of investigation only showed the existence of a single species.

It is known that sea sand contains fossil remains of all sorts of microscopic organisms. When examining a sample of such sand under the microscopic X-ray apparatus, a surprising abundance and variety of forms is revealed, each individual being analyzed far more safely than under the microscope. In addition to these applications, micro-radiography also lends itself for investigating the formation of the bones of small vertebrates from their birth to the adult stage. Apart from the structure of bones, peculiarities of the skin and any anomalies of small, though not microscopically small, animals can be investigated with the utmost care, any fleshy parts and even muscles becoming transparent so as to come out distinctly on the background. Studies in comparative anatomy are thus greatly facilitated.

Other applications will doubtless be found in the near future; those above mentioned would seem to give an adequate idea of the possibilities of this new science, the further development of which will be left to the experimenters themselves.

The Library of the Late Prof. Skeat has been presented to King's College, London, where, with the library of the late Prof. Furnivall, presented to the same college, it is to form a departmental library of the School of English Language and Literature.

The Heavens in February

How Astronomical Predictions Have Been Verified in the Laboratory

By Henry Norris Russell, Ph.D.

PROBABLY the most remarkable feat of astronomical spectroscopy has been its discovery (by its spectral lines in the light of the solar atmosphere) of the rare gas helium long before this element had been "run to earth" in our laboratories. A similar story, hardly less remarkable, has just come to its final chapter, by the production in the laboratory of a set of lines in the hydrogen spectrum, long ago known to exist in the stars.

In some ways this tale is even more remarkable than that of helium. It is easy enough to understand that when astronomers find in the spectrum of the Sun's chromosphere a number of lines that cannot be reproduced from any known substance, under any known method of treatment, they may legitimately assume these lines to be due to some unknown gas, and call it helium, from the place of its presumed occurrence.

But in the case now under discussion a number of spectral lines, never observed (till many years later) in the laboratory, have been confidently assigned to hydrogen, one of the most familiar of substances; and, what is more, the positions of other lines of hydrogen, never observed in the stars, and incapable of observation there, have been predicted; and, after fifteen years, these assumptions and predictions have been triumphantly verified by experiment.

To understand how these truly extraordinary things have been done, we must consider for a little the fascinating subject of series of lines in spectra.

In the spectra of many elements, there exist sets of lines, sometimes single, oftener double or triple, which show a regular spacing; the successive pairs lying nearer to one another, and becoming fainter toward the violet end of the spectrum. When the number of lines in the spectrum is great, it is often difficult to pick out such series, if they exist; but in spectra showing relatively few lines, the series are often the most conspicuous features.

Perhaps the finest of all examples of such a series is the great system of hydrogen lines which are so conspicuous in the spectra of the white stars (like Sirius) and appear also, with less intensity, in the solar spectrum. The same lines may be produced, without difficulty, by passing an electric discharge through hydrogen contained at low pressure in a "vacuum tube." As long ago as 1885 Balmer showed that the wave-lengths of these lines (which define their position in the spectrum) could be calculated with great exactness by the formula:

$$\lambda = 3{,}646.13\ \frac{m^2}{m^2 - 4}$$

in which $m = 3$ gives the wave-length of the red line (called C in the solar spectrum); $m = 4$, that of the blue F line, etc. The remaining lines lie in the violet and ultra-violet parts of the spectrum, and lie closer and closer together, crowding toward a definite limit. Only about eight of them can be photographed in the spectrum of the vacuum tube; but in the stars and the solar chromosphere, where conditions seem to be in some way more favorable, many more can be seen. In fact, all the lines of the series as far as $m = 31$ have been measured on Eversbed's eclipse photographs, and the agreement of the observed and calculated wave-lengths is practically perfect.

Study of other elements showed the existence of similar, but somewhat more complicated series. The alkali metals—sodium, potassium, etc.—show in their spectra *three* series of pairs of lines. The numerical formulæ for calculating their positions become simpler if we take, not the *lengths* of the light-waves, but the *number* of waves in a given distance, say a centimeter. When this is done, it is found that the interval between the lines of a pair measured in this way is exactly the same for all the pairs belonging to two of the three series, while the third series is composed of pairs which grow rapidly closer, as the lines lie farther to the violet.

The first two series of lines have the same limit, toward which the successive pairs converge; while the limit of the third series is usually far in the ultra-violet. This last series contains the strongest lines in the whole spectrum, and is consequently called the "principal series." The other two "subordinate series" of fainter lines may be distinguished from one another by the fact that the lines of one series are usually sharp, and those of the other usually diffuse when examined under high dispersion. These sharp and diffuse series are so arranged that the pairs of one sort and the other alternate in the spectrum, presenting a very beautiful picture, which can be seen by any one who can look, with a spectroscope of very moderate power, at an electric arc whose carbons are plentifully treated with some salt of sodium.

It will not do, however, to use a Bunsen burner, for, at the relatively low temperature of its flame, only the lines of the principal series of sodium are visible, and but one pair of these—the familiar lines in the yellow—lie within the visible spectrum. It is not until the atoms of the metallic vapor are exposed to the more violent disturbances, thermal and electrical, which befall them in the electric arc, that they begin to vibrate in the ways, and at the rates, which give rise to the lines of the subordinate series.

Very interesting numerical expressions for the wave-lengths of the lines of such series have been given by Rydberg, who uses equations of the form

$$\frac{1}{\lambda} = n_0 - \frac{N}{(m + \mu)^2}$$

in which m has the values 2, 3, 4, etc., n_0 and μ are constants, different for each series of lines, and N is a "fundamental constant," which is the same for all series and all elements, and must depend on some universal peculiarity of atomic structure.

The constant μ is usually not a whole number, but is less than unity. If we make it exactly unity, and give n a proper value, the formula reduces to that for the "balance series" of hydrogen.

When the equations for the different series are written in this way a remarkable connection appears between the "principal" and "sharp" series. In fact, the equations for the two may be combined in the formula:

$$\frac{1}{\lambda} = \frac{N}{(m_1 + \mu_1)^2} - \frac{N}{(m_2 + \mu_2)^2}$$

(considering for simplicity a series of single lines).

Here μ_1 and μ_2 are two constants. If we keep $m_1 = 1$, and give m_2 the values 1, 2, 3, 4, we get the positions of the lines of the principal series; while if we let $m_2 = 1$, and make $m_1 = 2$, 3, 4, etc., we get (after changing signs) the wave-lengths of the sharp series. It is obvious that if we know the lines of one of these series we can work out the formula, and then calculate where the lines of the other series ought to be.

This relation has been tested on several elements showing such series in their spectra, and found to be generally true (though not perfectly accurate, presumably because the exact formula is a more complicated algebraic expression).

The bearing of all this on hydrogen and astronomy is as follows: In 1896 Pickering discovered, on photographs of the spectrum of Zeta Puppis (now visible low in the southern sky) a series of lines in the middle of the intervals between the familiar hydrogen lines, and very like them. On measuring their wave-lengths, he found that they could be very closely represented if, in the well-known formula of Balmer, the values $m = 3\frac{1}{2}$, $4\frac{1}{2}$, $5\frac{1}{2}$, etc., were inserted instead of 3, 4, 5, etc. This was evidence enough to make it very probable that the new lines were really due to hydrogen, whose atoms were stirred up to vibrate (perhaps by very high temperature) in additional ways, besides those already familiar, just as happens to the sodium atoms in passing from the flame to the arc.

Rydberg, after Pickering's measures were published, promptly showed that the positions of the lines could be very accurately represented by a formula of his type. The two series of hydrogen lines appeared to be related just like the two "subordinate series" in the spectrum of sodium, etc., the familiar lines corresponding to the "diffuse" and the new to the "sharp" series. It was now possible, using the last formula which is written down above, to predict where the lines of the principal series of hydrogen ought to be, if the previous hypotheses were true.

One of these predicted lines of wave-length 4,688 on the usual scale, in the blue, agreed with the uncertainty of the measures with a bright line observed in the spectrum of Zeta Puppis and some other stars, and also in the spectra of some nebulæ, and (as was later shown) faintly in the Sun's chromosphere. The other predicted lines lay in the extreme ultra-violet, with wave-lengths less than half that of the D lines. For light of such short wave-lengths, our atmosphere is very imperfectly transparent. Thicknesses of a few feet, such as come into question in laboratory measurements, exert a moderate absorption; but the miles of air through which the light of the Sun and stars must come are, for these rays, entirely opaque.

There was hence no further possibility of testing Rydberg's brilliant hypotheses by astronomical means.

So the matter stood for fifteen years, until Prof. Fowler of South Kensington, a very distinguished spectroscopic authority, discovered, only a few months ago, that if a very powerful electric discharge is passed through a mixture of hydrogen and helium, in a vacuum tube, the lines under discussion can be observed. Hydrogen alone has not yet been made to give the new spectra; but from the reasons already given there is no doubt at all that it, and not the associated helium, is responsible for them.

The measured positions of the lines of longer wave-length agree perfectly with those observed in the stars, and the lines of the principal series are there, in just the calculated positions. An additional set of lines, intermediate between those of the principal series, and forming a fourth series, related to it very much as the other two series are related, have also been shown on Prof. Fowler's plates; but all these lines are so far in the ultra-violet that they are of no astronomical importance.

It would hardly be possible to find a more beautiful instance of the confirmation of scientific predictions; and all concerned in it—Prof. Pickering, Prof. Rydberg, and Prof. Fowler—may well receive the heartiest congratulations upon the completion of this almost romantic chapter of spectroscopic history.

At 9 o'clock: Feb. 6.
At 8½ o'clock: Feb. 14.
At 8 o'clock: Feb. 21.

At 9½ o'clock: March 1.

At 9 o'clock: Mar. 8.
At 8½ o'clock: Mar. 16.
At 8 o'clock: Mar. 23.

NIGHT SKY: FEBRUARY AND MARCH.

The Heavens.

The winter constellations are so familiar that we need not linger long over our map. We need only find Orion in the southwest, Cassiopeia in the northwest, Ursa Major in the northeast, or Leo in the southeast, all groups which, when once learned, cannot be mistaken for anything else; and then to fill in between them with the map as our guide. It is worth note, however, that the star Zeta Puppis (Argo Navis), which shows the series of hydrogen lines of which we spoke

(Concluded on page 128.)

The Fourth Award of the Scientific American Medal

An Oxygen Fed and Driven Device for Artificial Respiration

THE fourth bestowal of the SCIENTIFIC AMERICAN Medal was made with the usual care by the Jury of Awards of the American Museum of Safety on January 23rd at a largely attended meeting held in the auditorium of the United Engineering Society's building. Before the meeting, at which four medals were awarded, a dinner was served in the Rossiter W. Raymond room, which was attended by ninety distinguished guests, including Dr. and Mrs. Andrew Carnegie, Mrs. Thomas A. Edison, and many other persons well known in humanitarian movements.

President Arthur Williams presided at the meeting.

The SCIENTIFIC AMERICAN Medal was awarded to the Draeger Oxygen Apparatus Company of Pittsburgh, Pa., and Lübeck, Germany. The presentation address was made by Dr. Frederick H. Hutton.

In part Prof. Hutton said:

"It is the pleasant and precious privilege of the Museum of Safety to be the representative of the community and of you all in recognizing the splendid quality of altruistic service. It is the dream and inspiration of the Museum, that on some day the trustees may discharge this duty in its own building built and operated by the State, which has delegated its duties to it, and by the municipality which benefits principally by its activities, as well as by the generous co-operation of the individuals who recognize its opportunities. But, at present, we do this pleasant duty in a hall belonging to someone else; and the medals which we award are the gifts of individuals or corporations who have been keen-sighted to see that by endowing such a medal they were fostering and fanning the spirit of uncompensated service for industrial mankind.

"These medals are four in number. They will first be listed and the recipient named, with the reasons for the action taken; and then the delegated representatives will be asked to come to the platform, that the medals may be handed to them in person.

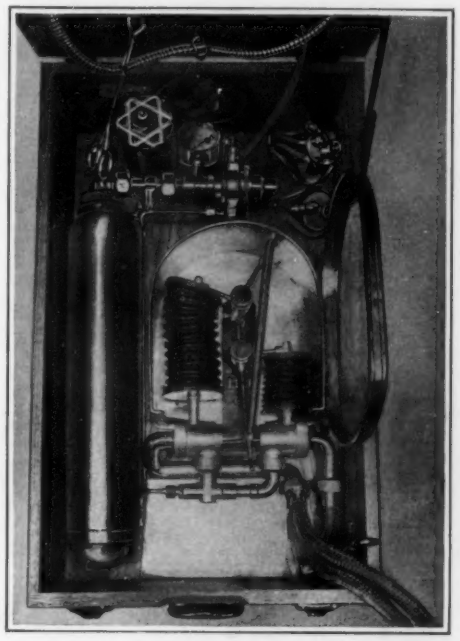
"The medals are listed in chronological order:

"The SCIENTIFIC AMERICAN Gold Medal must be for some safety or life-saving device, invented within a recency of three years, and exhibited in the Museum's collections. The device selected for 1912 in this class is the Pulmotor.

"The phenomena of respiration are combinations of mechanical action and chemical re-actions. The presence of poisons in the blood-current stimulates the brain cells, which automatically start up the muscles of diaphragm and thorax, whereby the chest cavity is expanded and air flows in to react upon the blood exposed to such oxygenating action. If the poison is excessive, if the lung cavity is filled with water, or if the chemical compound in the blood is stable or unbreakable, oxygenation does not take place, the nerve centers are paralyzed and death results. If the nerve centers are paralyzed by excessive electrical action, respiration stops."

We give herewith a description of the Pulmotor in greater detail than was possible in an address.

The Pulmotor, for which the specific award of the SCIENTIFIC AMERICAN Medal was made, is an oxygen-feed device designed primarily to induce respiration by artificial means in persons overcome by noxious gases, electric shock, the apparently drowned, or in any other cases where the breathing of the patient has been seriously impaired or stopped entirely, but where there still remains a slight heart action. The object of the apparatus is to inflate and deflate the lungs in a rhythmic manner, and the pulsations of the mechanism are so timed that about the normal number of respirations per minute is obtained. Its motive power is an oxygen cylinder containing this gas under a pressure of 150 atmospheres, which will supply a 60 per cent mixture of air and oxygen to the patient for forty minutes. Should it then become necessary, the empty cylinder may be replaced with a new one with a loss of but a few seconds. It has the great advantage over artificial respiration by hand in that it forces larger amounts of oxygenated air into the lungs than is possible by the ordinary methods of artificial respiration, and it makes it possible, through its automatic mechanical action, to keep up the work for long periods. The Pulmotor is so adjusted that it will force air into the lungs until it reaches a pressure of about 3/10 pounds, so that the same result is thus mechanically obtained as forced breathing in a healthy conscious man; therefore, when the three pounds pressure is reached, the apparatus reverses mechanically until it obtains a negative pressure of three pounds, so that all of the deoxidized air is thrown out, leaving the lungs empty and free for a new supply. This pressure is particularly valuable in cases of gas poisoning, because five atmospheres pressure will maintain oxygen in the blood fluid even after the blood cells have been so damaged by carbon monoxide that they are no longer able to maintain life, but life is maintained by this artificial means until the hemoglobin of the red blood cells, which normally carries the oxygen, can recover itself.

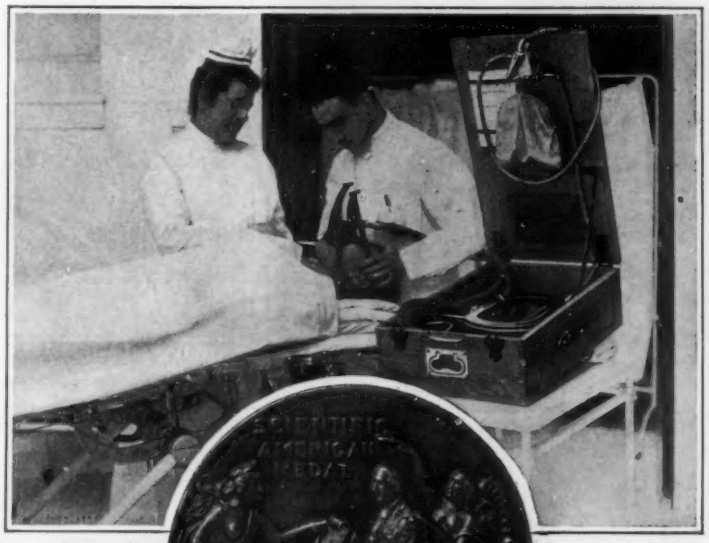


The pulmotor in its case ready for use.

The Pulmotor in its case weighs about fifty pounds, so that it can be carried about readily in automobiles, fire trucks, or ambulances. The wooden case contains two entire separate pieces of apparatus, an oxygen inhalation apparatus for ordinary oxygen inhalation (mounted on the lid of the case for use after life has been restored), and the special apparatus for artificial respiration, which is housed in the case itself. The two pieces of apparatus have in common the oxygen cylinder and the pressure-reducing valve, and either of them can be set in operation singly by turning a suitably arranged lever to the right or left upon the reducing valve. The steel oxygen cylinder is closed by a valve which can be opened by a turn of the thumb and finger. The cylinder contains 11½ cubic feet of pure oxygen. The oxygen passes from the reducing valve to an injector which has the property of drawing in a large volume of air with a certain force of suction, and propelling that air forward with equal force through the flexible tube in front of the injector. This suction and delivery injector, therefore, serves as a motor, alternately filling the lungs by pressure and emptying them by suction. The most striking part of the Pulmotor is a small leather accordion bellows, which effects the automatic reversal of the apparatus from suction to delivery, and *vice versa*, when essential. The bellows is connected with the air tubes. During inflation, the same pressure obtains in the bellows as in the lungs, and as soon as the latter are filled, the bellows becomes inflated, and in moving forward, causes the valve to be automatically reversed into position for suction. The operation is now reversed, and as soon as the lungs have been emptied, the bellows contracts and automatically reverses the valve again into position for inflating—and so on. From what has been stated, it will be clear that the respiratory rhythm of the apparatus readily adapts itself automatically to the capacity of the lungs in every case. The rhythm will be slow when the lungs are capacious, and faster with those of smaller dimensions. The apparatus performs all these functions without any assistance from the hands, so that the operator can turn his attention to an important thing, namely, keeping the wind-pipe open and closing the gullet. The essential condition to the success of artificial respiration is the provision of two flexible breathing tubes on the mask. One of these tubes serves exclusively for the supply of pure air and oxygen, while the simple inhalation apparatus can be called into play, and, as already stated, this portion of the apparatus is carried on the lid.

Some of the results obtained by the use of the Pulmotor are most remarkable. On February 15th, 1912, several Pulmotors were ordered for installation at as many Byllesby properties. Up to January 1st, 1913, twenty-four lives had been saved by the twenty-three machines, and a number of cases have been reported subse-

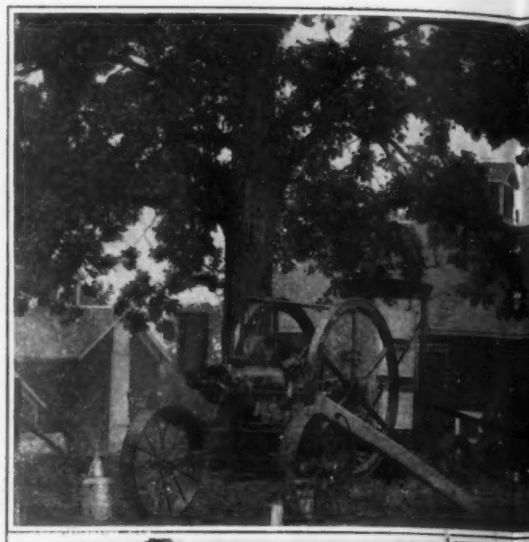
(*Concluded on page 122.*)



The pulmotor is of great help in the hospitals in cases where persons are overcome by noxious gases or fumes.

The pulmotor is brought to the point of rescue by an automobile, and the motorman is saved from the effects of electric shock.

Shelling corn with engine power.



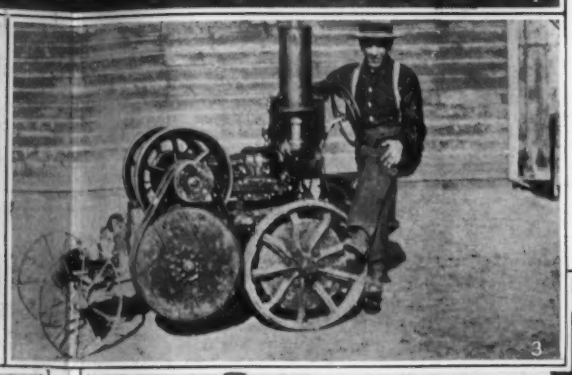
A pumping engine that can be used for many purposes. Gasoline engines can be bought at the rate of twenty-five to thirty-five dollars per horse-power.

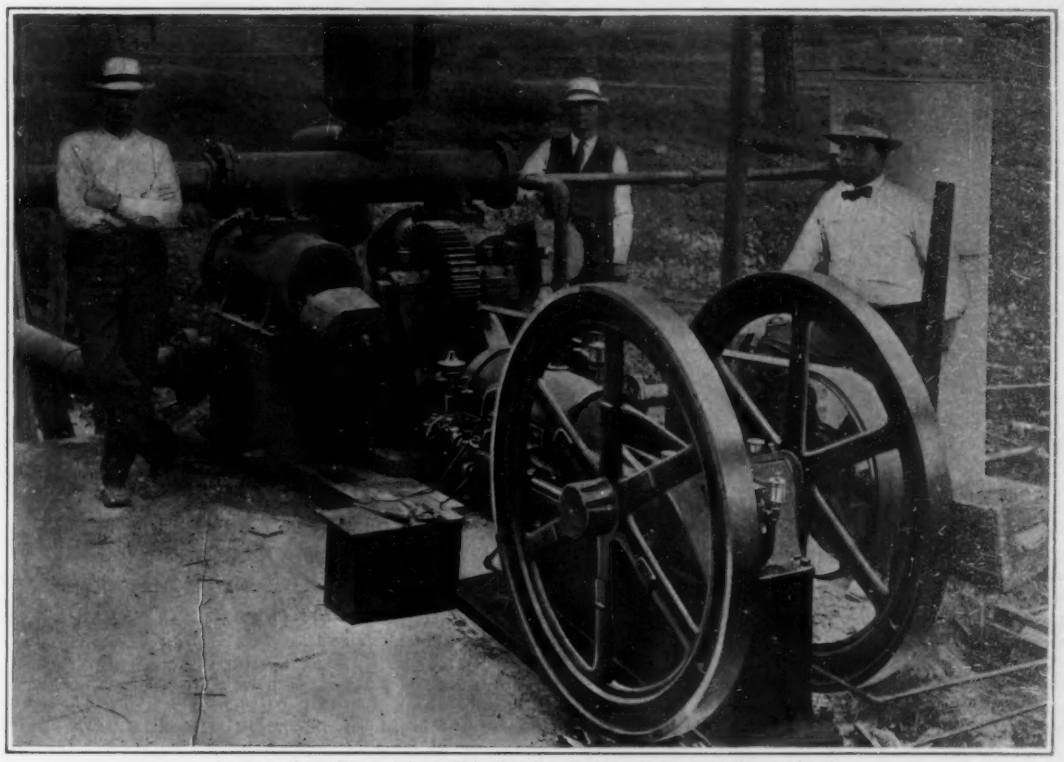
1. A corn fodder canning factory in operation. Machinery indispensable on th st literally thousands of these small home-made tractors in use. 4. A gasoline engin is

Threshing with a ten horse-power two-cycle stationary engine.

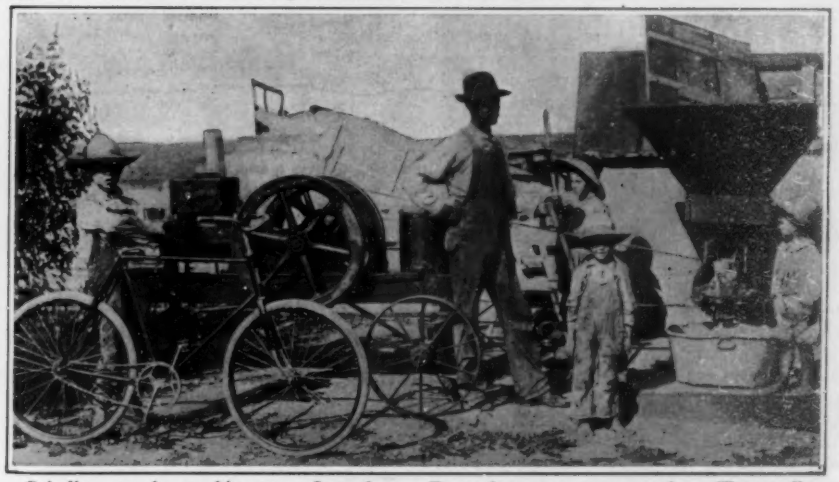
The business en of

A GROUP OF INTERESTING MACHINES AND ENGINES WHICH SHOWS HOW GASOLINE AND





A type of outfit that is reclaiming thousands of acres of desert land.



Grinding corn by machine on an Iowa farm. Every farm can use an engine. The small farm of only an acre or two needs at least one; the large farm can use several.

le on th stock farm. 2. A little pumping engine fitted to run a grindstone. 3. There are
ne engin is mounted upon this grain binder. 5. Cutting up a year's wood in a single day.

siness el of a tractor.

Baling the hay crop by machine.

OLINE AND OIL POWER CAN BE MADE TO DO THE FARMER'S WORK.—[For article see next page.]

Gasoline and Oil Power on the Farm

How Engines Have Lightened Farm Work

By Philip S. Rose

THE uses for the gas engine are legion. It is the mechanical chore boy of the farm, the Percy, or mechanical man of agriculture. It can be and is used in the house, in the barn, in the field and in the garden. There is hardly any place where there is work for a man to do that the gasoline engine cannot be used to advantage. It can be used in the house to run the washing machine and wringer, to pump water and furnish lights.

Many farmers have a small shop fitted up near the house where they have installed a shop for the repairing of tools, a laundry, an electric lighting plant, a cream separator, and perhaps a churn and other small machinery, all of which is run by a four or five horse-power engine.

An electric generator of two kilowatts capacity, with a storage battery, will light the house, the barn and the grounds; besides furnishing enough current to operate fans, flat irons, a sewing machine and perhaps a mechanical milker.

The cost of current so generated will not exceed ten cents a kilowatt hour, a figure that compares favorably with what the city dweller has to pay to the central station. If the shop can be built around the well, as many of them are, the same engine can also pump the water and deliver it to all parts of the farm buildings. One of these little machines makes it possible for every farm to have all the modern conveniences of the city home and at no greater expense.

Even if the same engine cannot be used to do all this work it costs very little to buy enough small units to take care of the various jobs that need to be provided for. The cost of a gasoline engine ranges from twenty-five to thirty-five dollars a horse-power whether the engine be large or small, so there is no economy in buying one large engine. It is better to buy several and place them where they will be needed most of the time.

Doing Farm Work with Gasoline.

Such engines will run on about a pint of gasoline per horse-power per hour, or with gasoline at sixteen cents a gallon, at a cost for fuel of only two cents a horse-power hour. The same amount of work with human labor will cost at least one dollar and twenty cents, for a man will charge at least fifteen cents an hour, and can do only one eighth of a horse-power of work. Furthermore, you know when you set an engine at work that it will not loaf on the job, and you are getting the full worth of your money.

If the gasoline engine had been invented and brought to its present state of perfection a hundred and fifty years ago we would never have had human slavery in the South. No slave, no matter how hard the task master, was ever able to compete with one of these mechanical men in the amount of work turned out in a day nor in the cheapness with which such work can be accomplished.

Our teachers of agriculture tell us that if we are to maintain the fertility of our soils and make a permanent success of agriculture we must raise more live stock. To do this we must grind feed, shred corn fodder and put up ensilage. Cattle and hogs and sheep cannot be allowed to pasture on high priced land; they must be kept in the stables and fed. Here then is where the engine of a little larger size can and must be used. Engines of twelve to fifteen horse-power, either stationary or mounted on trucks so that they can be moved easily from place to place, are the ideal size for this heavy work. In addition they can be used to thresh the grain, and many farmers are so using them. There are a number of small separators on the market designed for just this purpose.

The Cost of Filling a Silo with Power.

As an example of how efficient a gasoline engine is for filling silos all we need to do is to turn to a bulletin published by the Virginia Experiment Station which gives the report of experiments on the cost of filling silos with different kinds of power. It was shown in these experiments that the cost of filling a silo with gasoline engine power, using gasoline that costs thirteen cents a gallon, amounted to only two to three cents a ton as against two to seven cents a ton for steam engines using coal at five dollars a ton.

Another big field for the gasoline, or to be more exact in the use of terms, for the crude oil engine is in irrigation. Vast areas in Colorado, Texas and Kansas have been reclaimed with the use of such engines which pump from wells sixty, seventy and even eighty feet deep. Thousands of engines of from five to fifty or more horse-power are already in use and the number is daily increasing.

A gentleman who made a thorough study of conditions in the Louisiana rice fields last summer stated that in one parish in Louisiana alone there is an opportunity to replace fifteen hundred steam engines with an equal number of gasoline engines on account of the high price of coal and the difference in efficiency in favor of the gas engine.

Another large field of usefulness for the gas engine, though not directly concerned with agriculture, is in the cotton gins of the South. These are rapidly changing to the cheaper power.

In the fruit growing regions every fruit grower needs a gasoline spraying outfit and it requires one such outfit for every ten acres of orchard, because the time when spraying must be done is very limited and a day or two's delay means the saving or losing of a crop worth thousands of dollars.

Even the poultry farmer finds the gasoline engine indispensable for grinding bone and preparing food for his poultry, while market gardeners all through the humid belt circumvent the vagaries of the weather and overcome the handicap of a long drought by the use of some overhead system of irrigation. One manufacturer, who covers the territory east of the Mississippi River, has sold thousands of outfits that irrigate tracts up to ten acres or more in extent and prove sources of increased revenue to those forehanded enough to make use of them.

How Many Engines Are Necessary?

Thus it will be seen that every farm, no matter what the product thereof, can find profitable use for gas engine power. The small farm of only an acre or two needs at least one, while the large farms need several. One farmer writes that he has seven gasoline engines and finds them indispensable, while another reports five. A man engaged in mixed farming in Minnesota declares that every farmer on a quarter or a half section farm ought to have at least three engines of two, six and twelve horse-power, respectively. This man started out a few years ago with horses and men as his only source of power, and now has adopted gasoline engines everywhere he possibly can. He still uses horses, it is true, but with the small engines about the farm and a tractor in the field he finds it easy and more profitable to dispense with a large number of surplus horses and keep fewer hired men.

As an example of the value of one of these engines for special service, consider the special binder engine, which, mounted on the rear of a binder, operates the sickle and binder head and thus dispenses with two horses. Where the grain is heavy or the ground muddy it requires at least four horses on a grain binder, but with an engine to operate the working parts of the machine, two horses are sufficient. This was discovered a number of years ago in the Red River Valley when a heavy rain came on just when the grain was ready to harvest. The straw was very heavy and the soil so saturated with moisture that the wheels would fill up with mud and refuse to turn. A number of people then resorted to a gasoline engine fitted up on the rear of the binder, and in that way all that was saved that year of the wheat crop of the valley was saved by the aid of gasoline. Since then there has been a growing demand every year for binder engines. Wherever the grain is very heavy the little engine will relieve one team and do the work easier and cheaper. Last year, owing to the heavy straw, these engines were shipped from the factory to the grain fields in carload lots by express.

In parts of the country where there is much tile draining to be done special gas engine driven ditchers are coming into use. Some of these are home-made, some factory made. An example of one of the former type came under the writer's observation not long since in Iowa. It is fitted with a fifteen horse-power gasoline engine and is capable of digging twenty rods of trench a day for 36-inch tile at a fuel cost of only five dollars. There are millions of acres of land in this country that need drainage, and it is such machines as these that will make the work possible. If we had to depend upon human labor to do all the excavating the cost would be well nigh prohibitive, even though tile draining doubles and in some cases trebles the value of the land. One of these machines can easily do as much in a day as fifteen men.

The Experience of Farmers with Gasoline.

Instances of the use of gasoline engines could be multiplied almost indefinitely. The experiences of farmers everywhere are the same. Listen to what a few of them have to say in regard to this subject. Here is one from Indiana. He writes: "Three years ago I purchased a two horse-power engine to pump water from a hundred and fifty foot well. In the fall we used it to cut corn fodder, then fitted it up to a wood saw and later to run a small feed grinder. If I were buying another engine I would get a larger one, but I only expected to use this one for pumping until I realized its adaptability and added the other duties."

An Illinois farmer reports as follows: "We have three engines on our farm, one is two and a half horse-power, one six and the other eighteen. The small one is used for pumping water, washing, sawing wood and for all small jobs. I got the six-horse engine to run the corn dump and to help out the small engine. Later, I converted it into a tractor to more easily take it to the various jobs I wanted done. It is a success, too. The big engine is used to run a feed mill and has ground thousands of bushels of corn and oats for cattle feeding."

A New York farmer, evidently a poultryman, writes that he uses his seven-horse engine to run a pneumatic ensilage cutter, a meat chopper and a bone grinder, while a Nebraska farmer who kept an accurate record of his work writes that he sawed eighty-four loads of pole wood, each load averaging three quarters of a cord, in fifteen hours and fifty-five minutes and used only four and a half gallons of gasoline.

From all parts of the country come the same reports of adaptability, efficiency and economy. We are only at the beginning of the use of power in agriculture, but its use is spreading with tremendous rapidity. The era of power farming is upon us, and it seems destined to work almost as much of a revolution as did the entrance of mechanical power in manufacturing.

Farmers' Bulletins

THE publications of the U. S. Department of Agriculture during the last fiscal year included 2,110 different bulletins, circulars, reports, and other documents, of which 34,678,557 copies were issued. Of these 10,409,000 were Farmers' Bulletins. The series bearing the latter title represents one of the most remarkable examples extant of the activities of a paternal government. It now includes more than 500 titles, running through an almost exhaustively wide range of subjects of practical interest in connection with rural life and industries. For example, during the past year Farmers' Bulletins were issued on "House Flies," "The Use of Concrete on the Farm," "Forestry in Nature Study," "Tuberculosis," "Ice Houses," "Lawns and Lawn Soils," "The English Sparrow as a Pest," and some forty other topics. The publications of this series are all distributed gratis to the public, either directly by the department or through members of Congress, and although they are printed in large editions (from 20,000 to 250,000) the stock on hand is soon exhausted, and many applicants are disappointed.

The Current Supplement

THE Bureau of Railway Economics recently published a bulletin in which a study is made of the capital values and net returns of Agriculture, Manufacturing Industries, and Railways. The salient points of this important bulletin are presented in an abstract which appears in this week's issue, No. 1935, of the SCIENTIFIC AMERICAN SUPPLEMENT.—Dr. A. Nestler tells us many interesting facts about Plants Venomous to the Touch.—The Berlin correspondent of the SCIENTIFIC AMERICAN reports on recent work in "high frequency" moving pictures, in which no less than one hundred thousand photographs are made per second, showing the movement of a pistol lock, and the discharge of the empty cartridge.—Davis H. Tuck makes some interesting comments on the census of power production in the United States during 1912.—A number of industries, such as the manufacture of soaps and candles, make use of hard fats, as distinguished from oils, i. e., liquid fats. To these industries a process for converting liquid into solid fats is most valuable. Such a process is described in an article translated for our readers from a German source.—The capital of British India has by imperial act been transferred from Calcutta to Delhi. Some of the engineering and sanitary problems involved in the construction of the new city are discussed by Sir Bradford Leslie in an article illustrated with fine examples of Indian architectural art, the beauty of which may surprise those who have not made themselves familiar with these matters.—The function of micro-organisms of the soil in agriculture is lucidly discussed by G. T. Moore.

RECENTLY PATENTED INVENTIONS

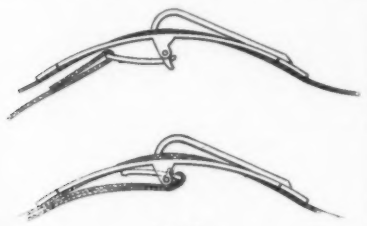
These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

GARMENT HANGER.—L. KALINA, care of Midget Mfg. Co., 178 Center St., New York, N. Y. This invention provides a hanger for supporting coats, vests, suits, trousers, skirts, shirt waists and other garments, and is adapted to be folded into a comparatively small space for convenient carrying in a vest pocket or stowing it in a traveling bag or other similar traveling article.

NECKSCARF.—T. DEWEY and F. J. DEWEY, Plattsburg, N. Y. This invention is intended more particularly for embodiment in four-in-hand and like scarfs in the form of a continuous band or strip of a length to constitute a neck band, and to be formed into a knot, leaving depending flaps or ends.

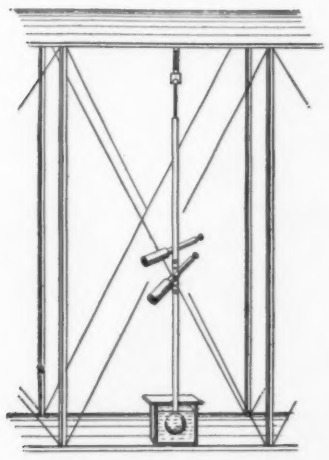
BUCKLE.—W. J. FRINK, 11 E. 4th St., Chattanooga, Tenn. The invention has for its object the provision of a holding device for a buckle, especially designed for ladies' belts, which can be attached to delicate fabrics without injuring them, without requiring the use of stitches, rivets, pins, or the like, and without regard to the thickness of the fabric. The device may be easily attached and detached.



BUCKLE.

Pertaining to Aviation.

SPEED FINDER FOR MOVING BODIES.—C. S. STANWORTH, 111 Warren Crescent, Norfolk, Va. To facilitate observation by means of this invention, fixed lines of sight are laid off at definite angles from a vertical bar, and the observer has only to note the elapsed time of the passage of the object across the two lines of sight, and by reference to a table the speed can be calculated, and the point at which it is necessary to release a projectile or mailbag so that it will strike within a given area can be determined. The principal advantage of the finder is that the lines of sight are fixed angles, and no manipulation of measuring instruments are required. A fragment of an aeroplane is illustrated herewith, showing applied thereto a speed finder.



SPEED FINDER FOR MOVING BODIES.

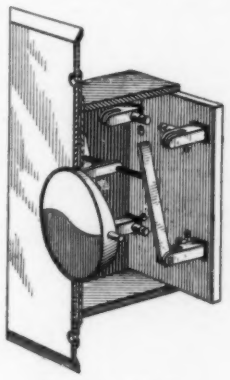
AEROMOTOR BOAT.—S. S. JERWAN and F. S. JERWAN, 21 Convent Ave., New York, N. Y. The invention is an aeroplane having a motor boat attachment so that the aeroplane can alight upon a body of water and propel itself over the surface thereof, or be caused to rise from the surface of the water and resume its flight whenever the operator desires.

AEROPLANE.—A. J. A. DEPERDUSSIN, 9 Rue des Entrepréneurs, Paris, France. This invention uses a controlling wheel mounted upon a pivoted bow or bridge of inverted U-shape, which spans the width of the fuselage, the ends of the arms of the bow being pivoted at two fixed points on either side of the fuselage, one of the arms of the bridge carrying the cables operating the altitude rudder. Such arrangement permits utilization of the rigidity of the main frames to resist the pull of the cables while the bridge allows room for the pilot's legs. Also the cables are separated the whole width of the frame; it is therefore convenient to connect them to the ends of the long horizontal arms of the three-arm lever placed upon the landing frame and having a short third arm attached to the operating cables which pass toward the planes over two pulleys located substantially at the same height as the end of the short arm.

Electrical Devices.

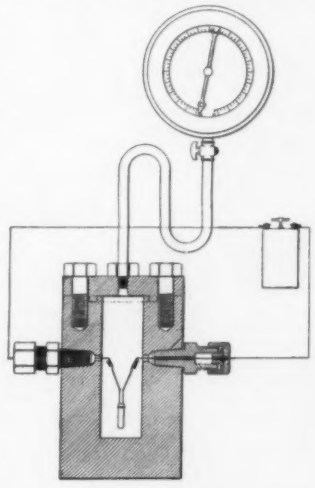
SYSTEM OF ELECTRICAL SUPPLY.—W. C. WOODLANDS, care of Packard Electric Co., Warren, Ohio. The principal object here is to provide a series lighting circuit which is inductively controlled, the system being arranged so that the load may be altered, the power factor remaining substantially constant. The system is inductively controlled through the medium of a suitable transformer, together with reactances in the primary and secondary transformer circuits.

ELECTRIC SWITCH.—C. E. KNOWLTON, 212 W. 3rd St., Rochester, Minn. The switch shown in the accompanying drawing is of the button type, the buttons being arranged to tilt on suitable journals so as to close or open the double knife switch. The switch is noiseless, and when the current is on the lower half of the button projects from the wall plate. To open the switch the button is tilted back flush with the plate.



ELECTRIC SWITCH.

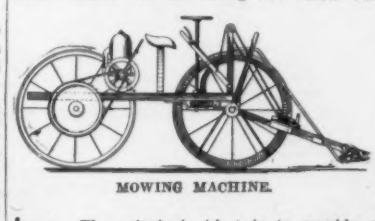
PRESSURE INDICATOR.—J. H. WILSON, 15th St. and Center St., Ashland, Pa. This invention is more particularly directed to a device especially adapted for testing the explosive pressure of detonators or blasting caps. The principal object is to provide a testing device whereby the explosive pressure in pounds exerted by a blasting cap or electric detonator will be directly indicated. It provides a testing device of substantial construction whereby the force exerted when a blasting cap or electric detonator explodes may be indicated directly on a pressure gage. The engraving shows in section the operative relation of the device, together with a blasting cap or a detonator suitably held in position therein and in circuit with a battery.



PRESSURE INDICATOR.

Of Interest to Farmers.

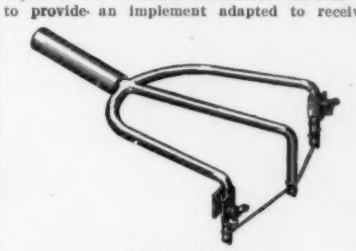
MOWING MACHINE.—A. J. ANDERSON, 22 Greenwich St., New York, N. Y. This machine is self-propelled and is provided with new and useful means for controlling the cutter bar frame. The principal object is to provide a machine having a plurality of bars thereon, the frame carrying the bars being more or less loosely constructed whereby these bars may adapt themselves to unevenness in the ground when the machine is in use. A further object is to provide means for removing the cutter bar driving mechanism out of operative position in order to permit the machine to be run over the ground with the bars inoperative. The illustration herewith represents the machine in a side view.



MOWING MACHINE.

AUTOMATIC MILK CAN FILLER.—J. W. MÜLLER, care of G. L. Thacker, Chehalis, Wash. The invention provides a means for filling milk cans, bottles, etc., in succession, the milk flowing into the first of a series of cans, and when the first is filled the milk is automatically shut off from this filled can and permitted to flow into the next can of the series, and so on successively to the end of the series of cans.

GARDEN RAKES.—JAMES DICKSON, Box 513, Goderich, Ontario, Can. The principal object of the invention illustrated herewith is to provide an implement adapted to receive a temporary device to shatter or agitate the ground through which it is drawn. This is effected by connecting the tines of the rake with a wire which, as the rake is pulled through the ground, serves to loosen the earth surrounding plants.

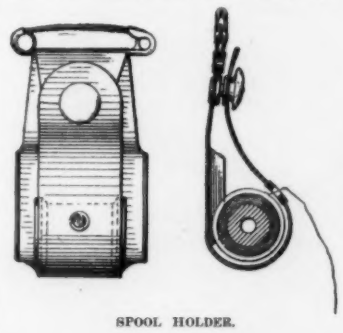


GARDEN RAKE.

MAPLE SAP EVAPORATOR.—G. H. SOULE, Fairfield, Vt. In this invention use is made of a heater, a pan adjacent to the heater and having a tortuous passage extending from one side at the rear to the front and back to the rear at the other side, inlet connections connecting the heater with the pan at both sides and at the rear of the pan, means for closing either connection and syrup outlets on the pan adjacent to the inlets.

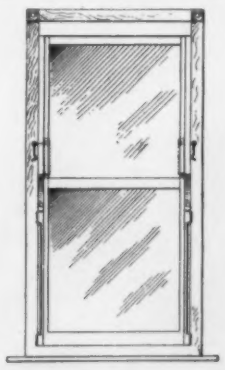
Of General Interest.

SPOOLHOLDER.—S. E. CREASEY, care of Sanford Novelty Company, Sanford, Maine. A spoolholder is provided in the present invention which may be conveniently attached to the garment of the person, and which provides not only a receptacle for a spool, but a delivery guide for the thread drawn from the spool and receptacle. The device is of compact form and may be readily kept in a workbasket when out of service.



SPOOL HOLDER.

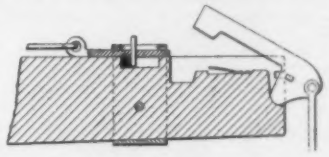
WINDOW.—R. B. HARTSFIELD, 210 W. 114th St., New York, N. Y. This invention relates to windows having stiles mounted to slide up and down, and sashes pivoted on the said stiles to admit of turning the sashes on the stiles. The purpose is to provide a window arranged to permit of conveniently turning the sashes with a view to allow cleaning of the outer faces of the sashes from the inside of the room. For this, use is made of a window frame having parting strips of fixed and movable sections and cross-bars carrying the sections and mounted to swing on the sides of the window frame to allow of turning the sashes on their stiles at the time the movable sections and their cross bars are swung into the outermost position. The engraving shows an inner face view of the window.



WINDOW.

BOOK LINE GUIDE RULER.—C. E. GOULDING, 1015 S. Dakota Ave., Tampa, Fla. This invention provides a ruler adapted for adjustment of disalined and separate book sections; provides an opeating mechanism for rulers to enable them to be adjusted to a margin; provides rulers to hold in adjusted position the open sections of books and to show the continuous line across the two half faces thereof.

HORSE RELEASING DEVICE.—R. E. CHANTRY, Big Arm, Mont. The object is a releasing device with clips to which the tug straps may be secured, the clips being disposed in recesses in the back of the swingletree, having forwardly extending shoulders disposed in bearing openings in the swingletree, and lateral arms disposed in the slots on the swingletree, so that the locking slides provided for engaging the back of the clips will hold the clips in position on the rear of the swingletree until the locking slides are drawn back, when the clips will pivot on their shoulders, and the inner ends of the clips be thrown free from the swingletrees. The engraving shows an enlarged sectional view of the end of one of the swingletrees, with the locking slide drawn back to free the clip.



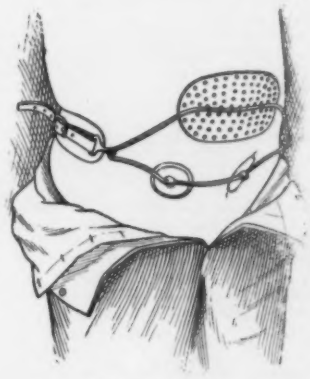
HORSE RELEASING DEVICE.

ANTISEPTIC PROTECTOR FOR MOUTHPIECES.—E. A. DIETERICH, 910 Caldwell Ave., Bronx, N. Y., N. Y. The inventor provides a protector for the mouthpieces of telephones, speaking tubes, and the like, and arranges to present to the user a thoroughly disinfected and agreeably smelling traveling web extending over the entrance end of the mouthpiece with a view to prevent contamination of the mouthpiece, and to protect the user against transmittable diseases.

TRUSS.—F. DASSORI, 1135 84th St., Brooklyn, N. Y. This invention is designed for the relief of sufferers of hernia, and is so constructed that it will hold any rupture, no matter how old, obstinate or recalcitrant, under all conditions, and without causing any inconvenience to the wearer.

DAM.—G. BLAAUW, 505 Pittsburgh Bank of Savings, Pittsburgh, Pa. The object here is to provide a dam preferably constructed of concrete or other suitable material which will possess the maximum amount of strength, rigidity and stability, with the least amount of material. A further object is to provide a structure in which the side thrust is resolved into a component, bringing the strain downward.

TRUSS.—E. PHELAN, Apartado 261, Guadalajara, Jal., Mexico. The pads of this truss are mounted on a bar which forms the lower part of a rigid frame, secured to the body by a preferably flexible strap. The frame is so formed that one side thereof projects in a direction at right angles to the general direction of the bar on which the hernia retaining pads are mounted, and is arranged so that the right angle portion will accommodate an abdominal pad which, acting against the belt, will give a leverage action for properly holding the hernia supporting pads to their work. A perspective view of the device as applied to an abdominal rupture is shown in the accompanying illustration.



TRUSS FOR HERNIA.

REVOLVING CARD STAND.—J. A. MANSON, 347 W. 87th St., New York, N. Y. The object here is to provide a revolving stand so constructed that the display cards may be readily dismounted and replaced. Another object is to provide a stand more particularly adapted to carry display cards such as is described in full in Mr. Manson's copending application, Serial No. 663,079, filed November 29th, 1911.

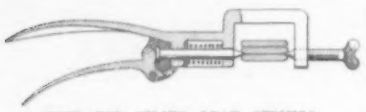
Hardware and Tools.

COMBINATION LOCK.—O. KATZENBERGER, 215 W. Huron St., Chicago, Ill. In this con

struction the combination can be easily and readily altered without access within the lock case, and further, it presents the engagement of the pin or finger with the disk tumblers from being detected in the working of the knob; also it provides for the positive actuation of the lock bolt in both directions.

FILTER.—C. E. BALLOW, Los Angeles, Cal. The principal object of the inventor is the provision of a cylinder filter having means thereon for rotatably mounting it in position whereby the device is capable of manual operation, thereby being adapted for use in places where such an outfit is desirable, but where power is unavailable.

TOOL FOR USE IN OILING LEAF SPRINGS.—H. HUTCHINSON, care of Elmer H. FINIGAN, Syracuse, Neb. In this invention the improvement is a hand tool for use in separating the leaves of elliptic or semi-elliptic carriage springs sufficiently to permit the introduction of oil or other lubricant between them



TOOL FOR OILING LEAF SPRINGS.

for the purpose of relieving friction between the leaves and enabling them to slide easily on each other. The accompanying engraving illustrates what is mainly a longitudinal section of the tool, the same being shown applied to a leaf spring shown in cross section.

SAFETY RAZOR.—G. F. PAUL, care of Munn & Co., 361 Broadway, N. Y., N. Y. Mr. Paul's invention relates to a razor, and more particularly to a safety razor, and has for an object to construct a safety razor in which a thin rigid blade may be adjustably positioned relative to a flexible guard, to dispose the

SAFETY RAZOR.

blade at different distances from the guard according to the requirements of the user. The engraving herewith shows a side elevation of the invention, the upper position being cut away centrally to represent certain portions in section and showing the position of the parts before the blade is clamped into position.

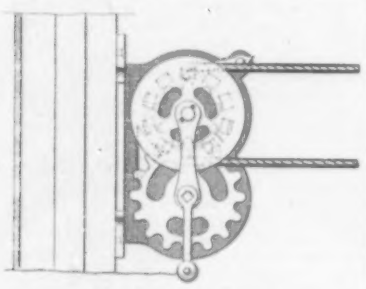
Heating and Lighting.

STOVE.—G. T. OGLESBY, 3411 S. Washington St., Frankfort, Ind. This stove provides for the continuous flow therethrough of air from the room which is to be heated. It provides means for causing the soot to be deposited at the top of the stove instead of being carried into the pipe, and in such a way that the soot so deposited will be burnt up and destroyed when the stove is in use.

Household Utilities.

SIPHON FLUSHING APPARATUS.—J. J. MEYER, 366 Lenox Ave., Yonkers, N. Y. This invention pertains to flushing tanks for water closets, urinals and other fixtures, and its object is to provide an apparatus arranged to draw the water out of the tank from above the water level in the tank so that all leakage and waste of water is prevented, and the tank is properly emptied of its contents by a siphon action.

CLOTHES LINE SUPPORT.—MAX RUTH, 89 Wegman Place, Jersey City, N. J. Mr. Ruth's invention relates to an improvement in clothes line supports, and it comprises a compact attachment that can be easily mount-



CLOTHES LINE SUPPORT.

ed upon the side of a house adjacent a window thereof, and by means of which the clothes line can be readily and conveniently operated to enable the wash to be hung out to be dried and taken in after drying.

Machines and Mechanical Devices.

AUTOMATIC SAW SHARPENING MACHINE.—E. S. BERRY, Putnamville, Vt. This machine is designed more especially for grinding, sharpening or gumming the teeth of straight or circular saws, and arranged to allow running the machine at a high speed, to quickly sharpen the saw, to insure positive intermittent feeding of the saw and positive movement of the grinding wheel to and from the saw, and to reduce vibration to a minimum and thus permit accurate and uniform sharpening of the teeth of a saw.

HAT FLANGING MACHINE.—T. J. MAC DONALD, 131 Nepperhan Ave., Brooklyn, N. Y. This machine is arranged to enable the operator to reach every part of the brim with a view to facilitate the setting and flanging thereof. For this operation the hat block is mounted to turn on the carrier adapted to be swung from a horizontal into an upright position or vice versa.

CABLE FOR THE TRANSMISSION OF MECHANICAL MOVEMENTS.—NICOLAS HERZMARK, 7 Rue de Poliveau, Paris, France. The purpose here is to provide a flexible cable for the transmission of mechanical movements of all kinds capable of acting by traction without stretching and by contraction without becoming shortened. It consists broadly of a core constituted by one or more wires contained in the interior of a tubular helicoidal winding with contiguous spirals, the core being in permanent tension between two stops which bear at each extremity of the cable upon the winding.

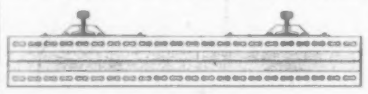
Prime Movers and Their Accessories.

PACKING.—G. E. WRIEDT, dec'd., W. A. Kruger, executor, 16 Newberry St., Providence, R. I. The object of this invention is to provide a packing more especially designed for use on piston rods, valve stems and the like, and arranged to allow convenient adjustment with a view to take up wear. For this purpose, use is made of a tubular packing made in sections and encircling the rod or stem, the sections being provided with conical ends, and rings having conical openings engaging the conical ends by holding the sections together and pressing the same against the rod or stem.

Railways and Their Accessories.

RAIL FASTENING.—S. B. KULL, 150 E. 45th St., Manhattan, N. Y. The aim here is to provide a rail fastening, arranged to securely hold the rail in place and to prevent spreading of the same. Use is made of converging spikes, of which one is the rail spike and engages the rail, and the other is the locking spike and engages the rail spike to lock the latter against displacement.

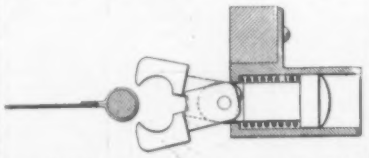
RAILROAD TIE AND RAIL FASTENER.—F. C. SEAMAN, 3 Academy Place, Oneonta, N. Y. The inventor provides improvements whereby the ties are rendered practically indestructible and the rails are securely held in place to prevent them from spreading. The tire is made in the form of a skeleton metal casing and a concrete filling, and the tie is provided



RAILROAD TIE AND RAIL FASTENER.

with recesses for the reception of rail supporting blocks for the rails to rest upon, and rail clamps bolted to the sides of each of the said rail-supporting blocks and engaging the corresponding rail at the opposite sides thereof. The illustration is a side view of the tie and fastener with the rails in position and shown in section.

AUTOMATIC SELF-RELEASING CURTAIN HOOK.—J. B. RUDOLPH, 373 Ocean Ave., Jersey City, N. J. The means at present in use for fastening the curtains connecting the bellows of adjacent railway cars, are defective for the reason that if the cars become uncoupled, unless care is taken to disconnect the curtain, the parting of the cars will tear or rip the same from their fastenings. The invention provides a fastening hook at the free



AUTOMATIC SELF-RELEASING CURTAIN HOOK.

edge of the curtain, to firmly hold the same under normal conditions, but which will automatically permit the release of the curtain when a strong pull is exerted on the latter. The edge rod of the curtain may be readily inserted, and the several parts of the device may be locked to change the same from an automatically releasing hook to a locked hook. The illustration shows the bolt and jaws in protracted position showing the curtain rod.

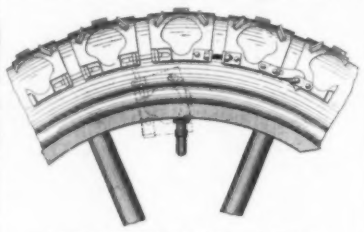
FEED WATER HEATER FOR LOCOMOTIVE BOILERS.—A. DENNETT and C. DIDIER, Santiago de Chile, Chile. The invention consists of a cylindrical feed-water heater for locomotives, which heater is disposed in the smoke-box directly above the passage for the exhaust steam from the cylinders, and is provided with a number of vertical tubes through which the exhaust steam is made to pass. On the top this heater is provided with a concentric conical hood for collecting the exhaust steam, which hood has a mouth piece serving as a blast-pipe.

CAR DOOR SECURING MEANS.—T. H. ABERNETHY, Box 172, Shelby, N. C. The invention pertains to a car door securing means and more particularly is directed to an improvement whereby the said means when released may serve the purposes of a lever to assist in opening or closing the door.

OPERATING DEVICE FOR STATION INDICATORS.—W. B. HILL, Hotel Seneca, San Francisco, Cal. The invention is an improved form of a station indicator previously patented by the same inventor. A drum is driven from a revolving part of the running gear, and the drum, and novel, co-acting, manually-controlled elements are designed to increase the efficiency and precision of operation and to simplify the adjustment and control.

Pertaining to Vehicles.

ANTI-SKIDDING DEVICE FOR TIRES.—I. D. MEALS, 306 Cumberland St., Harrisburg, Pa. This invention relates to devices attached to the tread of a vehicle tire, for preventing skidding, and more particularly to that class of anti-skidding devices comprising separate semi-circular sections coupled together around



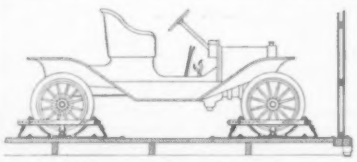
ANTI-SKIDDING DEVICE FOR TIRES.

the tire at the tread and sides. An object is to provide an anti-skidding device, consisting of a chain formed of sections as represented herewith in a side elevation of the invention as applied. It further consists in novel features of the special automatic coupling link, and its appurtenances, in the special form of a link uniting the other sections in the chain, and in the special form of the individual chain sections.

SIGNAL DEVICE FOR VEHICLES.—C. F. MARSTON, Great Neck, Box 113, Cedarhurst, L. I., New York. In this instance use is made of a casing for attachment to the rear of an automobile or like vehicle, and provided with an adequate signaling means connected with the brake mechanism of the vehicle so that when the brake is applied the signal will operate to inform the operator of a vehicle in the rear that the first vehicle is modifying its speed.

GEARING FOR TRACTION ENGINES.—J. T. METCALFE and G. METCALFE, care of Quincy Engine Co., Quincy, Pa. The object here is to provide a transmission especially adapted for use with explosive engines and capable of a plurality of forward and a reverse speed, wherein the motor is first yieldingly connected with a driven shaft, and afterward positively and rigidly connected.

VEHICLE CHOCK.—J. B. HARRISON, 295 12th St., Portland, Ore. In this patent the invention has reference to a means for holding a vehicle on a platform, and more particularly to means for fastening an automobile on a box car. An object of



VEHICLE CHOCK.

the invention is to provide a holding device which may be adjusted to fit different-sized wheels, and to fit the sets of wheels disposed at different distances apart. In the illustration is a side elevation of an automobile mounted in a box car by means of the invention.

ELECTRIC LIGHTING DEVICE FOR MOTOR VEHICLE LAMPS.—H. D. GRINNELL, care of Agricultural Nat. Bank, Pittsfield, Mass. This improvement provides a device for lighting acetylene and other gas lamps of automobiles and other motor vehicles, in a very simple and convenient manner, without stopping the vehicle or requiring the operator to leave the vehicle.

PUNCTURE PROOF TIRE.—W. MCKAY, care of Dr. I. G. Burton, 1181 Broadway, New York, N. Y. The aim in this instance is to provide a tire arranged to permit convenient assembling of the parts, and to protect the inner tube against being punctured by tacks or the like, at the same time producing the desired cushioning effect of the ordinary inner tube tire.

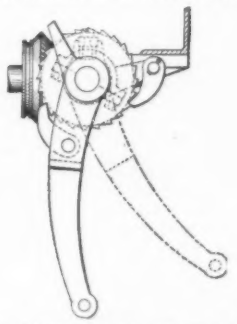
AUTOMATIC TRUCK BODY LIFTER.—L. P. COLE, JR., 106 Jefferson St., Weehawken, N. J. The invention provides an automatic truck body lifter arranged to permit of lifting the body of the vehicle off the truck or chassis and supporting the said body while loading or unloading it, at the same time allowing using of the truck on another body or for other purposes.

SPRING WHEEL.—J. LUNZ, P. O. Box 277, Belpre, Kan. The improvement is in spring wheels, and the object of the invention is the provision of a simple, inexpensive device, which while having approximately the resiliency of a pneumatic tire, will be devoid of the disadvantages of such tires.

SPRING CUSHIONED WHEEL.—S. W. BUERCKLIN, R. F. D., No. 2, Prague, Okla. The invention is an improved substitute for the penumatic-tired wheels commonly used on automobiles, autocycles, and other motor-propelled vehicles. It is particularly an improvement in spring wheels in which a pneumatic outer tire is disposed with and an elastic central or hub portion is substituted to provide the required resiliency for the wheel as a whole.

VEHICLE WHEEL.—T. T. CHALONER, 506 W. 47th St., Manhattan, New York, N. Y. The invention relates more particularly to a resilient wheel, and the object is to provide means for resiliently supporting an outer rim or tread member. Also to provide a wheel structure formed with an outer rim supported by springs and a plurality of resilient plugs projecting beyond the rim.

AUTOMOBILE STARTING DEVICE.—F. MISKOVSKY, 133 Brownell St., Providence, R. I. In the present patent the invention is a starting device for automobiles, by means of which the engine can be conveniently started from the operator's seat; and it includes certain novel features of construction which are



AUTOMOBILE STARTING DEVICE.

designed to minimize the liability of accident to the operator in case of backfiring, or the starting of the engine in the wrong direction. In the accompanying engraving is a view of a side elevation of the starting mechanism of the device.

SUPPLEMENTAL SEAT ATTACHMENT FOR MOTORCYCLES, BICYCLES AND LIKE MACHINES.—C. W. DUCKWORTH, 30 W. Adams St., Jacksonville, Fla. The invention provides an auxiliary frame carrying a foot-rest and a handle-bar, the auxiliary frame being connected at its forward upper end with the frame of the bicycle or motor cycle and being yieldingly supported from the rear axle of the machine.

Designs.

DESIGN FOR CARPET OR RUG.—J. G. PEGEL, care of G. S. Squire, 41 Union Square, New York, N. Y. The border and centerpiece of this carpet or rug design is decorative with geometrical figures of a very ornamental and original style, and between these the field is freely patterned with flowers.

DESIGN FOR A SOCK OR STOCKING.—G. E. BEERS, Lord & Taylor, care of J. C. Lay, 901 Broadway, New York, N. Y. In this design for a sock or stocking the reinforced heel extends upward to double the usual height and ends in an ornamental point.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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$2,000,000 Buried

By R. E. Olds, Designer

In Reo the Fifth, we bury at least $2,000,000 a year where few men ever see it.

That's somewhere about $200 per car.

It is not merely hidden. It is spent on extremes—on over-caution, some say.

And it may take months—even years, sometimes—to discover all that this buried money buys.

Not Charged to You

This hidden cost is not added to your bill. The price of this car will show that.

We save it all—and more besides—by unusual factory economies.

In one way alone—by building only one model—we save about 20 per cent.

By not changing models in any radical way we save a great deal more. That comes from right designing.

We build all our own parts.

And our factory efficiency is so well known that engineers from everywhere come here to inspect it. Magazine articles have been written about it.

That's the whole reason why a car like this can be sold for $1,095.

You Get Twice What You See

In Reo the Fifth you see a beautiful car—roomy and rich and impressive.

The body is finished in 17 coats. The upholstering is luxurious. Every detail shows the final touch.

Flush electric dash lights instead of the side lamps. Nickel trimmings, even under the hood.

But don't judge a car by these showy externals. That's mere body-building—easy, usual and cheap.

What to Consider

The chief points in a car are endurance and safety. And those depend largely on steel.

So I have steel for each part made to my formulas, based on 26 years of experience. Then I analyze each part—analyze it twice—to prove its accord with those formulas.

Then I give each important part vast overcapacity. I employ the same tests as are generally used for a 45 h. p. engine.

Instead of steel castings, which cost half as much, I use in this car 190 drop forgings. Thus hidden flaws are avoided.

Roller Bearings

I might say Timken bearings and use only two. But I use them for endurance, not claims.

There are no ball bearings in Reo the Fifth, save in the clutch and fan. There are 15 roller bearings. The usual ball bearings would cost one-fifth as much.

I use a $75 magneto.

I use a centrifugal pump.

My carburetor is double heated—with hot air and hot water. That saves a world of trouble.

I use 14-inch brake drums. I use 2-inch, 7-leaf springs.

Tires 34x4

This car is vastly overtired, and tires, as you know, are expensive.

I spend on tires about $60 per car more than other experts think necessary. But nobody doubts that I save my users from three to five times as much.

Then my tests and inspections are immensely expensive. I test my gears in a crushing machine with 50 tons' capacity. I test my springs in another machine, for 100,000 vibrations.

Each engine is tested 20 hours on blocks, and 28 hours in the chassis. I use three 10-hour tests which are very unusual.

Each car in the making gets a thousand inspections.

Parts are ground over and over to get utter exactness. And our output is limited to 50 cars daily, so no man is ever rushed.

Ideal Center Control

The leading cars, as you know, have come to left side drive. Also to center control.

But center control, in Reo the Fifth, doesn't mean the old side levers moved to the middle.

Our center control is a sort of cane handle. All the gear shifting is done by moving this handle only three inches in each of four directions. It's as easy and simple as moving the spark lever.

No reaching, no levers in the way. Both brakes are operated by foot pedals. Thus both front doors are clear.

The driver sits on the left hand side, close to the cars he passes. Yet his right hand controls the car.

This exclusive feature costs nothing extra. But if it cost $100 men would pay it, I believe.

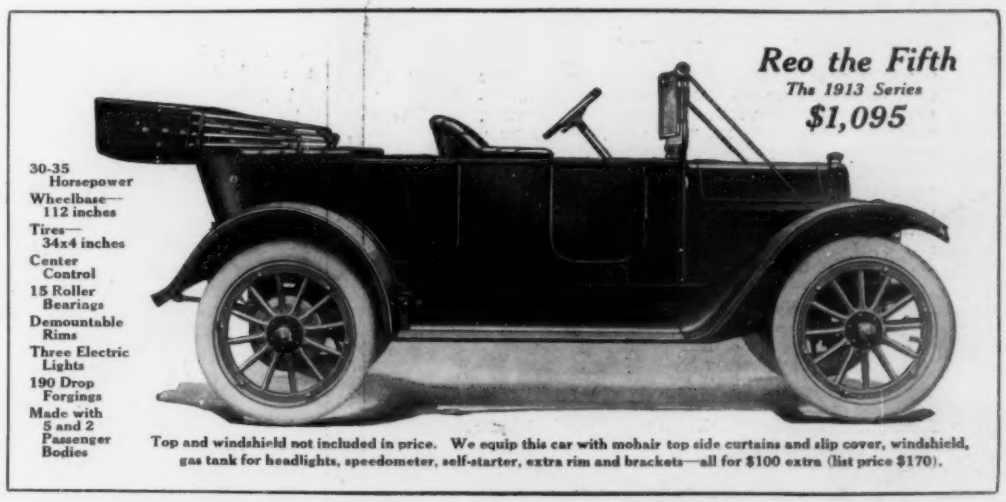
My Idea of a Car

This is my idea of an honest car. It is the final result of 26 years spent in building cars.

I would not buy a car built otherwise myself. So I shall never build one.

My success is due to these extreme ideas. So are my legions of friends among motor car users. This year I am seeking for 10,000 more such friends.

A thousand dealers handle Reo the Fifth. Write for our 1913 catalog and we'll give you the address of the nearest.



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Wheelbase—112 inches
Tires—34x4 inches
Center Control
15 Roller Bearings
Demountable Rims
Three Electric Lights
190 Drop Forgings
Made with 5 and 2 Passenger Bodies

Top and windshield not included in price. We equip this car with mohair top side curtains and slip cover, windshield, gas tank for headlights, speedometer, self-starter, extra rim and brackets—all for $100 extra (list price $170).

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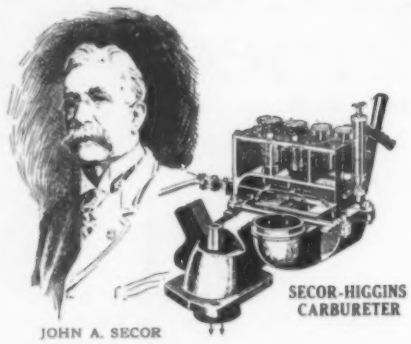
Rumely Bulletin No. 9

From Watt to Secor



JOHN A. SECOR

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Cheap Power.

To plow one acre, a steam tractor requires 1050 lbs. of coal and water, but a Rumely OilPull Tractor can plow an acre with *only 50 lbs.* of water and kerosene. For hauling, plowing, threshing, or any other similar power need, the Rumely OilPull Tractor has no equal. *It gives the highest percentage of result.*

Rumely Products Co.
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See next week's Bulletin

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Success of the County Agriculturist Plan

By Charles M. Carroll

THAT the farmers of this country are awakening to the necessity of employing modern, business-like methods in conducting their farms if they want to secure the best results, is becoming more apparent every day. The rapidity with which County Agricultural Bureaus are being formed all over the United States is the best proof in the world that the men who till the soil are beginning to realize that antiquated methods and old-fashioned ideas have no more place on the farm than in any other field of work.

There are now about 100 County Farm Bureaus in active operation in the different States; as many more have organized, but are not yet employing county agents, while the total number of counties applying for information with a view to establishing agricultural associations is 663.

It was two years ago that the Council of Grain Exchanges conceived the idea of placing an agricultural expert and adviser to the farmers in every county in the United States. The Crop Improvement Committee, with Bert Ball as its secretary, was then formed, and the raising of a national fund to carry on the work was started. This fund received a stimulus last spring in the shape of a million dollar donation from Julius Rosenwald of Chicago, who has set aside this sum, one thousand dollars of which is to go to each of the first thousand counties that are willing to co-operate in the work.

Two of the first counties to avail themselves of this offer were Kankakee County, Illinois, and Pettis County, Missouri. While the two counties proceeded along similar lines in forming their associations, each has worked out certain individual details of peculiar advantage to itself. The Crop Improvement Committee itself takes no active part in the organization of these Farm Bureaus, each county being left free to act as it sees fit. The committee simply recommends a line of procedure which will enable it and the county committee to make a satisfactory agreement.

The farmers and business men of Kankakee County were quickly impressed with the great value of the Crop Improvement Committee's plan, and determined to win the notable honor of being the first county in the United States to qualify for one of the thousand-dollar donations. A few far-sighted men behind the scheme had a dream of double crop production—of prosperity resulting from these bounteous yields that should make Kankakee County the best place in the world to live in. The idea caught the imagination of the people of Kankakee County. Farmers, bankers, millers, manufacturers, joined hands to raise the money needed to put the bureau on a permanent basis and carry out the other conditions prescribed by the Crop Improvement Committee. In less than two weeks more than $10,000 was raised, and the organization, known as the Kankakee County Soil and Crop Improvement Association, was incorporated with a capital stock of $50,000.

Prof. John S. Collier, of the Agricultural Department of the University of Illinois, was engaged as the association's expert. His duties are to advise the farmers, individually and collectively, as to the best methods of cultivating their farms, to point out the troubles and prescribe the remedies, to organize clubs, associations, etc., to give practical farm demonstrations in crop rotation, soil building, farm management. In short, he has been employed by the association to show the farmers how to get more from the same amount of land and how to make what they produce of better quality.

Prof. Collier proposes to plat every farm in the county, and to have a complete history of each, together with a soil analysis. As there are about 2,500 farms in the county it will require some time to complete this task, and he is taking up the farms of the members of the association first.

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Inquiry No. 9287. Wanted to buy a machine which will reduce cobs to meal—not a machine for shredding the cobs, but a machine that will pulverize them.

Inquiry No. 9288. Wanted the names and addresses of concerns that can coat steel balls with pure tin one-sixteenth of an inch thick.

Inquiry No. 9289. Wanted substance melting at 225° and hardening when cold without imparting any flavor to tobacco smoke and without emitting any oily or fatty vapor.

Inquiry No. 9290. Wanted name and address of a manufacturer of a patented device which is suitable for making up pay envelopes, namely, to fold up bills and insert them with minor coins in a pay envelope of the usual size.

Inquiry No. 9291. Want to buy machinery for manufacturing woode. tooth picks.

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Inquiry No. 9293. Wanted the names and addresses of manufacturers of waterproof cloth, also samples of such cloth

Inquiry No. 9294. Wanted to buy glass balls 1½ x 1¼" in diameter.

Inquiry No. 9296. Wanted name and address of some glass manufacturing company who can make patent lamps.

The county authorities have contributed the use, rent free, of four commodious rooms in Kankakee's new half million dollar county building as the association's headquarters. There are, in addition to Prof. Collier's private office, a large meeting room, a library containing several hundred books of agriculture, a rest room for the farmers' wives, and a large playground for the farmers' children. A completely equipped agricultural laboratory has also been established in the Kankakee High School.

As soon as the association had been formed, work was started to form from ten to fifteen co-operators in each township in the county. These co-operators send regular reports of the progress of crop improvement in the different townships to Prof. Collier. Arrangements are now being made with the National Government whereby domestic science will be made part of the county farm bureau, the work to be in charge of a competent woman who shall make a study of home life throughout the county, and act as adviser to the farmers' wives, as Prof. Collier is doing with the farmers about their fields.

Usually the soil expert spends the larger part of half a day on each farm, going over each field and giving advice as to its management. Then there are numerous emergency calls to be attended to. One day it is a man who wants to know what to do for corn worms; the next it is a man who wants to know why his rye straw falls down.

Another plan of the Kankakee farm bureau is the formation of a seed testing association, which will make it possible to insure clean tested seeds for every farmer in the county. The idea is to erect a seed-house in Kankakee, equipped with seed cleaning and seed grading machinery of the most approved type; that no seed be accepted here except that ground by members of the association under its rules. In this way it is urged that the association would gain national prominence, second to none on earth, on account of the superiority of its seed. The estimate is made that clean and tested seed alone will add half a million dollars to the crop value of the county.

The seed testing and seed selection work has been given a stimulus by getting the school children interested in it. By what is called the "Rag Baby Test," a ten-year-old boy or girl can quickly ascertain whether seed is good, bad or indifferent. It is the plan of the Kankakee County farm bureau to widen the scope of this work among the children and put the little ones in competition with their fathers and older brothers.

The organization of a farm bureau in Pettis County, Missouri, was due to the Boosters' Club of Sedalia. Early in the history of the club its members realized that anything that could be done for the practical benefit of the county would redound to the benefit of the city, and with that idea in mind they promoted the building of rock roads, better livestock, more extensive dairying and improved methods of marketing.

Sedalia is a city of about 21,000, and Pettis is regarded as one of the best counties in the State, having approximately 3,000 farmers whose lands vary in worth from $50 to $200 an acre. A close scrutiny of federal and State crop statistics, however, compelled the humiliating consciousness that Pettis County crop yields, particularly of corn and wheat, were much too low. Why? Something was wrong. What was the cause of this condition and how could it be remedied?

These questions confronted the club, and it decided that the farmers of the county would have to change their methods or quit farming. The conclusions drawn, after careful study, were that what the county needed and should have was the services of an expert, practical farm adviser.

About this time the State Board of Agriculture gave Pettis County a farmers' institute date at Sedalia, with S. M. Jordan as the speaker. After hearing Mr. Jordan's lecture on corn and how to in-

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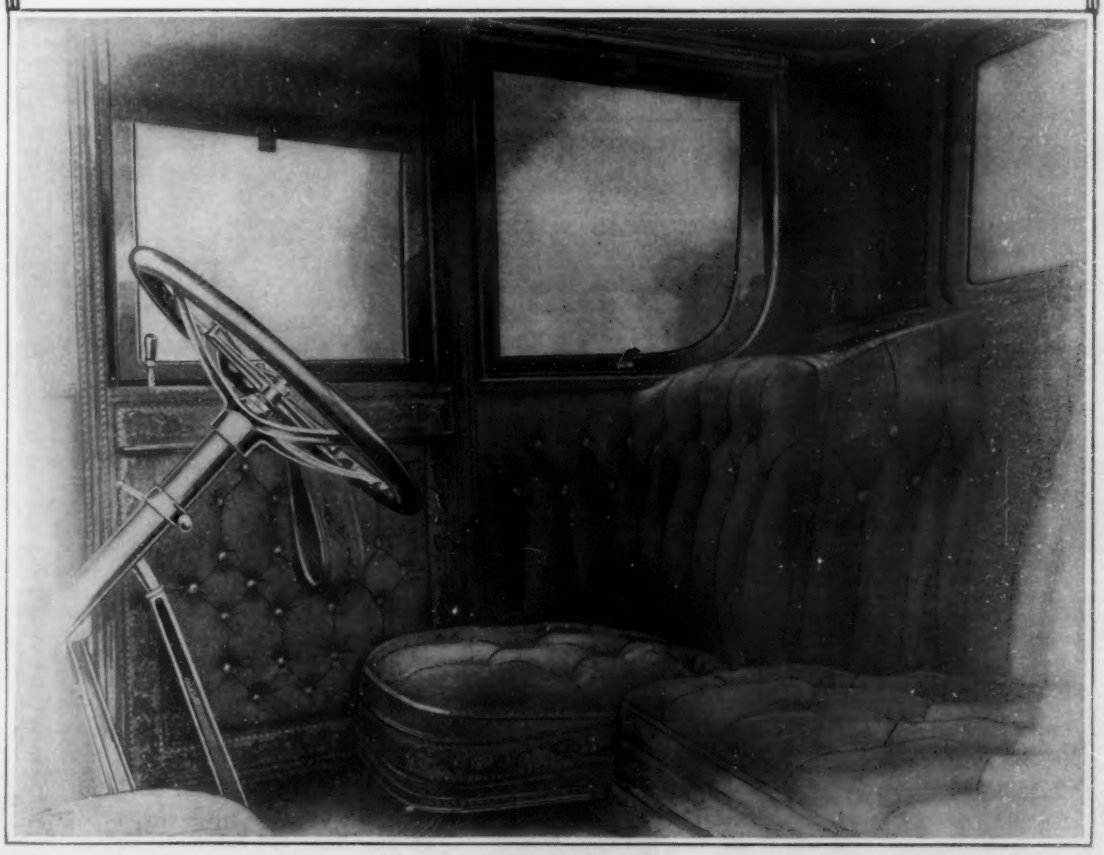

Interior Arrangement

The illustration shows the interior arrangement of the Cadillac Coupe. The driver's seat is about 8 inches forward of the wide rear seat. This gives greater elbow room. To allow entrance from the driving side, the driver's seat folds back. There is ample room on the wide rear seat for two passengers beside the driver, and the fourth passenger occupies the front seat, which may also be folded up if desired. The trimmings and appointments are elegant in the extreme. The four side windows may be lowered, and they are specially made to be vibration-proof, whether up or down.

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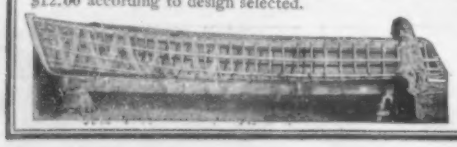

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crease its yield, the club decided that he was the man they wanted. The result was that they engaged him on the spot at a salary of $3,000 a year. Within six days much more than the required amount to put the bureau on a solid foundation was raised and the Pettis County Bureau of Agriculture was established. It now has a membership of over 500. There is not one of these members who is not of the opinion that should Mr. Jordan die to-morrow, the county has already realized in the short space of eight months benefits five times his total cost for a year.

Before Pettis County got Mr. Jordan there was a universal saying that "you can't grow alfalfa in Pettis County—we've tried it and know." Mr. Jordan didn't believe it and has proved that it can be done. In over 200 soil tests he made, with a single exception, every one was sour—so acid that alfalfa would not grow. He showed the farmers how by the use of lime or ground limestone, 1,000 to 4,000 pounds per acre, their soil could be sweetened, then by thorough preparation and use of good seed they could grow alfalfa. More than forty Pettis County farmers sowed it last spring under Mr. Jordan's direction, and in every case an excellent crop was obtained.

Through long continued "corning" of land, robbing the soil, scrub seed and scrubbier culture, the corn of Pettis County ran as low as 25 bushels per acre. Mr. Jordan corrected this, all phases of it. He found that adulterated seeds were being sold in the county. He began testing seeds and quickly put a stop to this practice.

At the farms Mr. Jordan visited several neighbors would assemble. This suggested holding institutes out on the farm with whole families in attendance, basket dinners and all-day affairs. These were held throughout the county, sometimes as many as 600 people being present on one farm. Frequently return dates were asked for.

Secretary Ball of the Crop Improvement Committee estimates that the amount required to run a county farm bureau will seldom exceed one per cent of the tillable land in the county, but not less than $100 for each township.

"We advise raising a local fund of from $2,000 to $5,000 a year for at least two years," said Mr. Ball. "There are so many things that can be done to develop the county and make the plan a success if money is available. We are not in favor of running it on the cheapest possible basis. We always advise getting the best man in sight and paying him what he is worth. I know of one county which pays its expert $4,000 a year. He undoubtedly will prove cheaper than the men other counties are hiring at $1,200 a year.

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"The National Government has made arrangements with us to go ahead and organize as many county farm bureaus as possible, and as soon as the federal appropriation is available it will take our place in the fund and pay possibly one half the expenses of the farm bureau in each county the second year and thereafter. We are also making arrangements whereby the direction of the county agriculturist will be merged in a State leader, who shall represent both the United States Government and the State Agricultural College."

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Coming Army Aeroplanes

By C. H. Claudy

AFTER all necessary expenses are paid, and the present aeroplanes of the army provided with needed repairs, etc., the Signal Corps will have about $35,000 of the 1913 appropriation left for the purchase of new aeroplanes. This sum will buy not more than four, and probably not more than three new machines.

The past four years have been largely experimental so far as practical aviation in the army is concerned. The Signal Office, having the work in charge, has been more concerned with the development of what was needed, with the ascertaining of the possibilities of aviation as affecting the service, than in the making of an aeronautical arm of the service fitted for offensive work. Out of the many experiments, the countless flights, the many changes made in machines, certain very definite plans have come into being, and certain well defined ideas have grown. These plans and ideas will, in all probability, be incorporated in the specifications for new Signal Corps aeroplanes, which will soon be published, and on which aeroplane makers will be asked to submit bids.

Definite announcements cannot be made as to the contents of these specifications, but it is very probable that the first and perhaps the most far-reaching of the new requirements will provide that no aeroplane with a motor developing less than 80 horse-power will be considered. In other words, it is no longer the minimum power and the lightest motor which is desired, but the lightest motor which will develop sufficient power to provide for emergencies and permit both speed and carrying ability.

The aeroplanes, which manufacturers will be invited to bid upon, will probably be required to possess stream-line inclosed bodies, and this specification will be applied as rigorously to the biplane as to the monoplane. Both for the protection of the aviator and observer from wind and cold, and in order to reduce head resistance, the inclosed type of body is now thought to be advisable.

Pictures of the Curtiss flying boat, purchased by the Signal Corps for army experiments, show something of what an inclosed body looks like. The flying boat, however, has a larger and clumsier inclosure than is wanted on the new aeroplanes, which are not required to be capable of running upon the water.

As revolutionary as anything in army flying machines anywhere in the world, will be the requirement that the new machines be armored. Experiments are now being made to determine the minimum thickness and weight of the finest laminated chrome steel armor, designed for aeroplane use. This chrome steel armor must be thick enough to protect the aviator from rifle fire at a height of two thousand feet, or a range of two thousand feet at an angle up to forty-five degrees, yet thin enough not to impede the carrying capacity of the craft.

An attempt will be made to equip the new aeroplanes with a radio-telegraphic apparatus, to be supplied by the Signal Corps itself, the only requirement regarding it for the aeroplane builder being, perhaps, the incorporation of a generator with the flywheel of the motor, and the provision for the carrying of the weight of the apparatus. The Signal Corps has succeeded in sending radio messages from an aeroplane for a distance of fifteen miles. So far no success whatever has been had with attempts to receive any wireless messages in an aeroplane, the noise of the motor, of the chains, when the propellers are chain driven, and the rush of air from the propellers, making the feeble beats of the message in the telephone headpiece completely inaudible. It is not improbable that at some future time some sort of pillowed headdress may, in conjunction with a well muffled engine, permit wireless messages to be received in the aeroplane. But the design will want some working out. It is pointed out that the problem is one of acoustics

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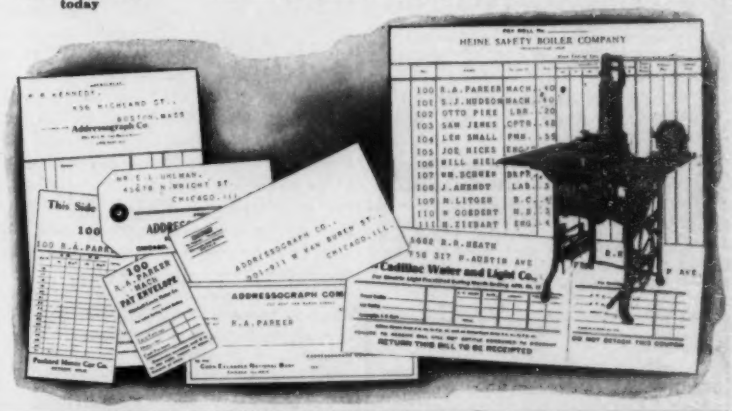

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and not of an electrical nature, and that any headdress which could be worn in an aeroplane, for noise-deadening purposes, would necessarily be both large, cumbersome, and, in warm weather, rather uncomfortable to wear.

It is expected that the new aeroplanes will all be equipped by the makers with a tachometer, a compass, an aneroid, a barograph, a map holder, a pad and pencil holder and a clock, and that the maker will provide the weight-carrying ability necessary to take care of these things. Two-place machines generally are desired for Signal Corps use, and a minimum speed of forty miles is probable. Fuel and oil capacity will probably be required for at least four hours flight, and undoubtedly the old style of endurance tests will have to give way to the modern idea of cross-country tests. Builders must make machines in which they are not afraid to risk themselves across country, rather than those which they are confident will stand up well in four hours circling of a parade ground. One man control will give way to dual control, so that either observer or pilot can manage the machine, and undoubtedly there will be fair restrictions made as to climbing ability and quick starting. Probably the former will not exceed 2,000 feet in ten minutes nor the latter be more severe than is indicated in the ability to rise from plowed ground or a long grass field in 100 yards distance.

Agriculture at Columbia University

GENTLEMEN farmers of New York city are not generally supposed to know much about the actual methods used on their out-of-town places. About all they know is that vegetables are raised on them, are supplied to the table in the summer, and that the cost has not been many times the amount they would have to pay to the country farmer in their neighborhood. When the question arises as to the proper handling of the land under cultivation an expert is called in to give his opinion, a big fee is paid him, and the land works well for a few years, when again the expert is called in and the proper treatment is advised again. This is about as expensive a method of farming as could be imagined, yet it is going on all the time on hundreds of country places near New York.

To meet this state of affairs the Department of Agriculture at Columbia is holding a series of lectures by men of scientific training and attainment—in fact, by the very men who are called in from time to time by the gentlemen farmers—on Tuesday afternoons up to March 19th, at 4:30 P. M. While these lectures are necessarily scientific, they are divested, as much as possible, of technicalities, and the New York farmer may easily learn the proper conduct of his farm. The lecturers are drawn from the national or State agricultural departments and from the schools of agriculture all over the country, many of them having farms of their own upon which the most advanced methods of farming are being carried out.

The aim of the course, which has been arranged by O. S. Morgan, professor of agriculture at the university, is to give chief consideration to the fundamental, practical aspects of the various phases of farming that should be weighed by every farmer manipulating land for crop or animal production about New York city. The competent housewife is always able to secure and keep better servants, so the gentleman farmer, who knows the subject, will be able to make his farm a greater success by use of the facts to be learned at these lectures.

Removing Paint From Glass

TO remove paint from glass a strong and hot solution of acetic acid should be applied with a cloth. As this is very effective, care should be taken that the solution does not touch painted wood surfaces. The solution is harmless to the hands and may be applied directly to the glass from a cloth steeped in the solution.

The Planets in February

(*Concluded from page 116.*)

above, is now easily visible low in the south. A line from Betelgeux in Orion through Sirius, carried as far again, points it out.

The lines in its spectrum are not very strong, and it would be difficult to observe them visually without powerful instrumental aid. Gamma Velorum (Argo Navis) just visible on a clear night, some 8 degrees farther down, is a more promising object for the amateur, for its spectrum is of the "fifth type," and shows a broad, bright band coinciding in position with the blue line on the principal series of hydrogen. This is so bright that it can be seen with a direct-vision spectroscope placed over the eye-piece of a telescope of moderate size.

The Planets.

Mercury is in conjunction with the Sun—behind him—on the 12th, and is practically invisible during February. Venus is splendidly placed in the evening sky, being at greatest elongation on the 12th, 47 degrees from the Sun, and remaining in sight till 9:15 P. M. With the telescope she appears as a perfect half-moon, and to the eye she exceeds Sirius tenfold in brightness. Mars is morning star in Capricornus, rising about 5:20 A. M. at the end of the month. Jupiter is also a morning star, but is farther west than Mars, in Sagittarius, and rises about 3:45 A. M. on the 28th.

Saturn is in Taurus, well past opposition, but conspicuous in the evening sky. He is in quadrature with the Sun on the 16th, and crosses the meridian at 6 P. M. Uranus is morning star in Capricornus, and is observable only at the end of the month. He is in conjunction with Mars on the 25th, being 26 minutes north of the ruddy planet. This would be a good time to find him if only the necessary hour of observation were more convenient.

Neptune is in Gemini, and comes to the meridian about 10 P. M.

The Moon is new at midnight on the 5th, in her first quarter at 4 A. M. on the 14th, full at 9 P. M. on the 20th, and in her last quarter at 4 P. M. on the 27th. She is nearest us on the 21st, and farthest away on the 7th. Since full Moon coincides so nearly with perigee, the tides will run high about that date.

During the month the Moon comes into conjunction with Jupiter on the 2nd, Mars on the 3rd, Uranus on the 4th, Mercury on the 5th, Venus on the 10th, Saturn on the 14th, and Neptune on the 18th, none of the observable approaches being close.

Princeton University Observatory.

Clarifying Beer by Gelatinous Silica

SUCCESSFUL attempts have been made by P. Deprax, according to *Les Ann. de la Brass. et de la Dist.* to clarify beer by means of gelatinous silica, especially those dense beers which are difficult to clarify by the use of fish-glue.

One hundred grammes of the jelly containing 17 per cent of the dry silica are sufficient to clarify one hectoliter of beer in the course of ten hours.

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The Mississippi as a Conveyer of Material

FROM a large number of analyses of the waters of the Mississippi River it is estimated that the great stream carries annually into the sea, during the average year, 136,400,000 tons of dissolved salts, and 340,000,000 tons of mud and other suspended matter—a total of 476,400,000 tons of material extracted by the Mississippi and its tributaries from the rocks and soils of its drainage basin.

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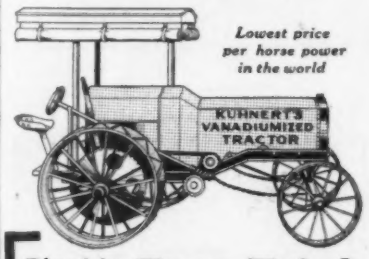

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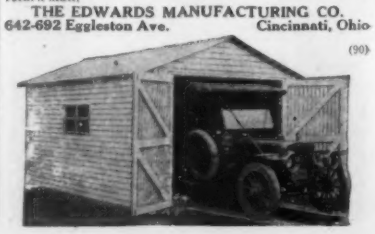

Notes and Queries

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(12737) A. A. C. asks: Will you kindly give directions through the "Notes and Queries" column for filling a barometer tube accurately, using only such apparatus as is found in a good high school laboratory? A. The usual method of removing the air bubbles from the mercury in a barometer tube is to take a piece of iron wire—No. 24, Brown & Sharpe will answer the purpose—and wind one end of it around a short piece of cotton wicking. Run this to the bottom of the tube. It should pass somewhat loosely, so that the mercury will flow past the wicking. Now fill the tube with mercury, and draw the wire up the tube. The cotton wicking will sweep the air bubbles off the glass. The wire may be run down the tube and drawn up any number of times till the bubbles are all removed. Another way of making the swab has recently been described. Wind one end of an iron wire into a spiral which is somewhat smaller than the bore of the barometer tube. Into the turns of this spiral pass some soft cotton wicking, and proceed as before. This seems to be an improvement, because the wire will fit the tube better, and the mercury will run through the middle of the spiral better than past the wad of cotton as described above.

(12738) G. F. C. asks: In which of the three classes of levers does the claw hammer belong? A. In a claw hammer the power is applied by the hand on the handle of the hammer, the weight is the resistance of the nail to be drawn, and the fulcrum changes along the back of the hammer as the nail is pulled out. This you will see makes it a lever of the first class. If your question refers to the use of a hammer in giving a blow, it was not necessary to specify a *claw* hammer, and the answer is not the same. The weight to be moved is the head of the hammer. The power and the fulcrum are both in the hand. If you regard the hammer as moving on the thumb side of the hand, then that side of the hand is the fulcrum, and the power is applied with the fulcrum in the middle, and the lever is of the first class. If you regard the hammer as moving on the opposite side of the hand as a fulcrum, it is a lever of the third class, with the power between the fulcrum and the weight. It is wholly as you regard the action of rotating the hammer on the hand. The best way to settle such a question is to try it and see. Watch some one striking with a hammer. Your request for the answer in the *next* issue of the paper is a very common one. You will see however that most of the paper must be written some time before it is published. It must be set into type, made up into pages, proof-read and corrected, printed, folded, wrapped, addressed, and mailed so as to reach the subscriber on the day of publication, as it is dated. All this takes nearly or quite a week of hard work for the editorial and office forces. Only when something very unusual happens is the work stopped to insert it as a special item.

(12739) W. B. asks: 1. Do I understand aright that in the summer months in northern latitudes, say Albany, the sun rises apparently north of east? In other words, that the sun will shine on the north elevation of a building, standing directly east and west, both morning and evening. If so, please explain in a layman's vernacular. A. It is quite true that the sun in the summer half of the year, from March 21st to September 21st, rises to the north of the east point of the horizon and sets to the north of the west point of the horizon, so that it is above the horizon longer than it is below and the daytimes are longer than the nighttimes. The sun shines near its rising and setting on the north walls of houses, which face north and south, during all this period. If you have never noticed this, you can easily verify this apparent motion by observing the point on the horizon where the sun rises or sets for the next year. You will see that point advance toward the north till June 21st and then retrace its path to the south until the 21st of next December. The sun is the center of the earth's motion during the year, and the axis of the earth is inclined nearly 23 degrees 30 minutes to the plane of the earth's orbit. This causes an apparent shifting of the place of the sun north and south, since the axis of the earth is always in the same absolute direction in space, or nearly so. The north pole of the earth is directed more toward the sun in June than in December by 47 degrees, or twice 23 degrees 30 minutes. 2. Also explain why, although the shortest day is on December 21st, the sun begins to set at a later period four days previous, that is, why do the evenings grow longer sooner than the mornings in this part of the year? I inclose copy of calendar which shows sunrise and sunset during December, with notations of length of days in hours and minutes. A. The second question, as to the change of sunrise near December 21st, is answered by saying that the clock and the sun are together but four times in a year, and noon or *midday*, at all other times is either before or after twelve by the clock. Clocks do not keep the time of the sun which we see, but of an *imaginary* sun which moves regularly around the sky in a year. This is necessary because the real sun does not move uniformly, but is going fastest at this season of the year and slowest about July 1st. Clocks cannot keep with a sun which moves irregularly; hence, they are made to go regularly, and they go ahead or fall behind the sun as may be the case. Only four times in a year are the clocks with the sun. There are two causes of this irregularity of the apparent motion of the sun. The first is that the motion of the earth around the sun is not regular. It is going fastest about January 1st, and slowest about July 1st. The second is that the day's marches of the earth are reckoned on the equator of the heavens, while the earth actually moves in the ecliptic. The combination of these two causes produces the result we have described. Midday, or true noon by the real sun, is always midway between sunrise and sunset; but 12 by the clock is not midway between sunrise and sunset excepting on four days of the year. December 24th is one of those days. The sun rose at 7:17, or 4 hours 43 minutes before 12, and set at 4:43 after 12. The morning and afternoon were of the same length. The time by which the clock is away from the sun is called the Equation of Time and may be found in any good astronomy. We recommend that you read Todd's "New Astronomy," which we send for $1.45. You will find all these questions explained in that book, and we think you will be much interested in it. We are not able to explain these matters except in the language of astronomy, although we hope we have avoided unfamiliar technical terms.

(12740) R. E. P. asks: I will be obliged if you will answer the following question in your Notes and Queries column: Is it better to keep a watch running continually or to let it run down and rest during periods when not in use? A. Watchmakers always say that a watch should not be allowed to run down and lie without running. The principal reason seems to be that the oil will gum upon the works, and when the watch is started it will not keep good time until it is cleaned and oiled.

(12741) P. S. F. asks: During the night of January 2nd, after several hours of rain, there fell about four inches of snow here, the first snowfall of the winter. On top of this snow were thousands of angle worms, scattered in some places, in other places quite thick. One place I counted fifty on a space ten feet square. Where did these worms come from? They could not possibly have crawled up through the snow. If they did not crawl up out of the earth, they must have fallen there. Is there any scientist that can answer this question, or will the answer be just a theory? A. We cannot account for the fall of worms as described in your letter. Such instances have been reported in other places. Small frogs and little toads are said to have fallen as well as worms. They may have been taken up in some other places and fallen out of the cloud at your place. It is not probable that a scientist can give any better explanation of such a matter than a common-sense man.

(12742) R. K. asks: Will you please tell me where I can find information in regard to generating electricity from steam or compressed air or from heat? I have been experimenting with steam, but have not accomplished anything practical yet. Any information you can give me will be greatly appreciated. A. All electricity for light and power is generated by the use of steam engines or water power. Any book upon the steam engine will be in the line of your question. But if you want a book upon the direct generation of electricity from steam, or compressed air, or directly from coal, we must say that nothing has been accomplished in these lines, although much time and money have been spent in the search for such a method of producing electricity. In the back numbers of our SUPPLEMENT you will find articles telling of these researches. We send you a catalogue, and shall be pleased to supply you with any numbers you may order.

(12743) H. P. asks: Will you be kind enough to answer the question below by mail and oblige? Some time ago a corps of engineers in running a line for a railroad came to a point where the needle refused to work; the ground was elevated, and repeated trials brought the same results. On the elevated point the needle would dance and could not be kept still or reliable. The ground is underlain with iron ore, but this has never before affected the usefulness of a compass. I would very much appreciate a reply or some explanation. A. We are not able to explain what you write about the behavior of a compass needle in a certain place over iron ore. There is no reason why a needle should "dance," or refuse to come to rest, in such a place, but it would not come to rest in a correct direction. It would be deflected to the east or west. Nor can we explain why the needle should have been reliable in this place before and not on this occasion. A compass needle is usually deviated from its proper position by iron ore in the earth near the surface, but not with such behavior as you describe. The line run by the compass in such positions simply wanders farther and farther away from its correct direction, and the error becomes greater and greater till the survey is of no value.

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ENGLISH LITERATURE: MEDIEVAL. By W. P. Ker, M.A. New York: Henry Holt & Co. 16mo.; 256 pp. Price, 50 cents net.

HERALDS OF THE MORNING. The Meaning of the Social and Political Problems of To-day and the Significance of the Great Phenomena in Nature. By Asa Oscar Tait. Mountain View, California: Pacific Press Publishing Association, 1912. 8vo.; 419 pp.; illustrated.

OFFICIAL AMERICAN TEXTILE DIRECTORY, 1912-1913. Compiled by the Textile World Record. Boston: Lord & Nagle Company. 8vo.; 664 pp. Price, office edition, $3; travelers' edition, $2.

We have before taken occasion to mention favorably this textile directory, which is published annually in July. The present issue maintains the standard of fullness and accuracy that has marked former issues. There are reports of all the textile manufacturing establishments of the United States and Canada, together with a yarn trade index and lists of concerns selling to or buying from textile mills. More than 13,000 different concerns are listed; there are 23 maps; and a vast amount of further information is so presented, classified, and indexed as to make the work invaluable to those who require some such volume of reference.

MODERN ORGANIZATION. By Charles Delano Hine. New York: The Engineering Magazine Company, 1912. Price $2.

In this excellent little book, the republication in permanent form of a series of articles on the unit system prepared by Major Hine for the *Engineering Magazine*, we have a most interesting and instructive description of the system that Mr. Julius Kruttschnitt has introduced on the Harriman Railway Lines, comprising about eighteen thousand miles of railway, employing between eighty thousand and one hundred thousand men and women and earning annually about $225,000,000. Obviously, so vast a system must be most efficiently organized if it is to operate with success. That it does operate with success is a matter of common knowledge. How that end has been attained, is one of the chief objects that Major Hine has undertaken to set forth. In the brief space of this review, it is impossible to unfold the method whereby success was achieved. Suffice it to say, that it lies in the decentralization of detailed activity and substituting for it centralized control. In a felicitously worded preface to the book, Mr. Charles Buxton Going, the editor of the *Engineering Magazine*, points out very aptly that the policies advocated are most interesting, because "they depend so little upon mechanisms of any kind, so little upon system affecting rank and file or the equipment and material, and so much upon psychological influences operating first upon and then through the directing officials."

THE NEW INDUSTRIAL DAY. By William C. Redfield. New York: The Century Company, 1912. Price, $1.25 net.

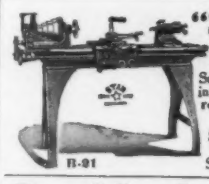
If anyone needs to be convinced that American manufacturers are on the whole a healthy-minded set of men, surely the literature on efficiency engineering and scientific management which has appeared within the last few years, and which has been eagerly bought and read, gives ample evidence of it. Like most of his predecessors, Mr. Redfield is more philosophic than practical in his treatment of efficiency. Therein, to our mind, lies its chief value. No two industries are so exactly alike that the application of efficiency principles to one is a guarantee of their success when applied to the other. Therefore, what is wanted is an optimistic, stimulating, exposition of correct sociological views, a vivid presentation of the relation that should exist between employer and employee, and a correct estimate of the debt that the body politic owes to the manufacturer and the manufacturer to the body politic. Mr. Redfield's book shows how necessary it is to imbue each man engaged in business or manufacturing with the idea that he is but a single element in a vast piece of machinery, the perfect operation of which depends in a certain measure upon his efficiency, on his sense of social justice, on his conscience.

DACTYLOGRAPHY OR THE STUDY OF FINGER-PRINTS. By Henry Faulds. Halifax: Milner & Co., 1912. Illustrated.

In this excellently written book we find a very clear and compact presentation of the whole subject of finger prints, including its history, as well as its practical application. The subject is becoming of such increasing importance (finger prints are now used not only by the police for the detection of criminals, but also by the army authorities for the identification of deserters and by banks as a check against forgery) that a popular yet accurate book is really needed. This Mr. Faulds has supplied.

MODERN ILLUMINATION. Theory and Practice. By Henry C. Horstman and Victor H. Tousley. Chicago: Frederick J Drake & Co., 1912. 12mo.; 273 pp.; illustrated. Price, $1.50.

Theory is here everywhere subordinated to the conditions of practice, the aim being to aid electricians, architects, and those interested in commercial and industrial establishments, rather than to furnish a text-book for the student or theorist. The material has been arranged with this object in view, and the principles of light and illumination are discussed only so far as is necessary to a practical consideration of special conditions. In addition to installation and location of lamps, there are chapters dealing with the color of light, the choice of lamps, the choice of fixtures, and indirect lighting. Apartment buildings, ar-



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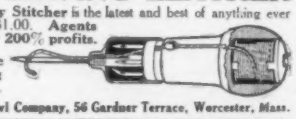

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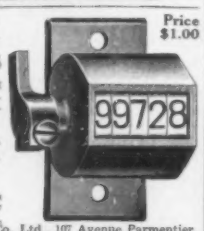

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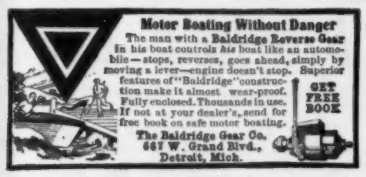

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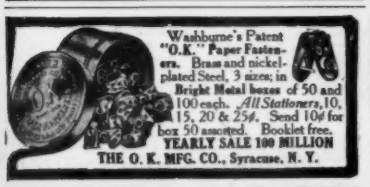

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cades, armories, studios, art galleries, ball rooms, all have consideration as to the particular system of lighting best adapted to their peculiarities, and a table of intensities is appended. The chapter on plans and specifications also contains a great deal of valuable information.

LE CALCUL DES PROBABILITES ET SES APPLICATIONS. Par E. Carvallo, Directeur des Etudes a l'Ecole Polytechnique. Paris: Gauthier-Villars, 1912.

In the calculus of probabilities, mathematical difficulties are only too abundant. To avoid them, they must be known. The theory of games furnishes all that can be desired in the way of problems, since the arbitrary combinations are unlimited. Here we have a rich crop of ingenious devices, of elegant solutions, of surprising paradoxes. Fortunately, if their attractions are great for mathematicians, their utter uselessness is certain for the majority of investigators. The author has therefore suppressed entirely the theory of games. Only a few examples have been retained, which by reason of their simplicity are amenable to definition and to ready explanation. Much of the book is devoted to the methods of statisticians. Naturally, the theorem of Bernouilli plays an important part in the discussion. To follow that discussion the reader must be something of a mathematician. Yet despite that requisite, the book is interesting reading even for the general reader.

THE SPELL OF ENGLAND. By Julia de Wolf Addison. Boston: L. C. Page & Co., 1912. 8vo.; 433 pp.; illustrated. Price, $2.50 net.

"The Spell of England" is one of the best volumes of "The Spell Series," which is saying a great deal. Possibly the author's childhood in England is partially responsible for the sympathetic treatment. But this must of course have been supplemented by mature observation and judgment before so intimate a description, covering so wide a territory, could be written. The volume is replete with humor as well as with charm. Indeed, refined, characteristic humor has always a charm of its own, and there is never too much of it. History, scenery, modern manners, architecture—all are treated lightly, briefly, yet lovingly, and the result is a very readable and instructive work. The illustrations from special photographs are always a feature of this series, and those in hand are fully up to the standard. The frontispiece in colors, of Caesar's Tower, Warwick Castle, is a particularly faithful and beautiful reproduction.

ROADS, PATHS AND BRIDGES. By Logan Waller Page. New York: Sturgis & Walton Company, 1912. 16mo.; 263 pp.; illustrated. Price, 75 cents net.

Mr. Page is director United States Office of Public Roads; president American Association for Highway Improvement; and a member of the American Society of Civil Engineers. With all these qualifications he should be able to impart some very instructive information on a topic of the most vital importance to the country at large. And, within the scope of so compact a work, Mr. Page has fulfilled all expectations. He truthfully says at the beginning that road building is an art based upon a science. A deep knowledge of any art or any science can be acquired only at the expense of years of study and practical application. But the farmer and the country gentleman may find even a superficial knowledge, provided it be grounded in true principle, most useful and beneficial. And it is with this particular end in view that the author writes. Locations, surveys, plans, and specifications are made the subject of an early chapter. This is followed by chapters on the various kinds of roads—earth, sand-clay, gravel, broken stone and macadam. Maintenance and repair receives the attention worthy of so important a branch of the subject, and a paper on the construction of culverts and bridges concludes a most useful and practical work.

THE AMERICAN IN PANAMA. By William R. Scott. 5×7½ in.; 258 pp.; 28 illustrations. New York: Statler Publishing Company.

We give our hearty commendation to this interesting and illuminating work by a former employee of the Isthmian Canal Commission. The book shows the great advantage, we had almost said the necessity, of anyone who writes a book about the Panama Canal doing so from the inside and on the spot. Mr. Scott tells us he discovered that had he followed the usual method of coming into the Canal Zone on the steamer, taking notes and leaving on the next steamer, he would have missed many fundamental facts which absolutely must be known if a really trustworthy account of the work is to be given. He is correct also in his belief that the average American layman desires an authoritative history of the project, and that he particularly desires a non-technical review, one which distinguishes events from mere incidents, and that is not burdened with a mass of details which make it difficult to keep in mind the essential facts. The work opens with a historical review of the history of events at Panama under the Spanish, French and American occupation. Credit is given to President Roosevelt for the great impetus which he gave to this work. The author is not pleased with the moral aspect of Mr. Roosevelt's settlement of the political difficulties, as he makes very clear in a chapter entitled "Taking the Canal Zone." The development of the work is traced first under Wallace, then under Stevens, and finally under Goethals. Credit is given to the first two for blazing the way, and particularly to Stevens for outlining what is practically the present organization and method of doing the work. Not very much space, and yet sufficient for the purpose of the book is devoted to a technical description of the dams and locks and the big cut at Culebra, and the work closes with a very readable chapter on the Monroe Doctrine.

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(Concluded from page 117.)

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Electrene resting in cup and held by Clamp

"Which Is the Better Extinguisher?

"A fire department chief in a western city writes to Fire "and Water Engineering for the following information:

"Will you kindly let me know which of the two small fire "extinguishers now on the market is best adapted for use on "motor cars? I notice that one of these machines is worked "like a squirt gun, being pumped with one hand while it is "directed with the other. In testing I found it difficult to "get a straight stream on a blaze on account of having to pump "it with one hand. Now, what I want to know is, whether the "other machine that is operated by compressed air is not better "suited for our purpose? I found that there was no difficulty in "directing and testing straight streams from this appliance "while holding it in position with both hands. On this point "I consider the pressure extinguisher has a great advantage "over the squirt gun, but would like to have your opinion upon "it before making a final decision."

"[With reference to the above inquiry we think, with our "correspondent, that it is best to use a machine that can be "held firmly with both hands while directing the stream on a "fire. It may be possible for a hand-pumped machine to pro- "duce some good results, but it certainly is handicapped by "not having both hands free to direct the stream.—Editor.]"

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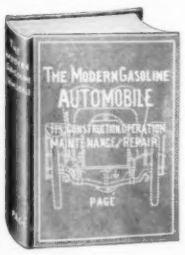

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Scientific American Supplement 528 describes Inclined-shaft Rotary Engine, using the universal-joint principle.

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